MAY 16 1988

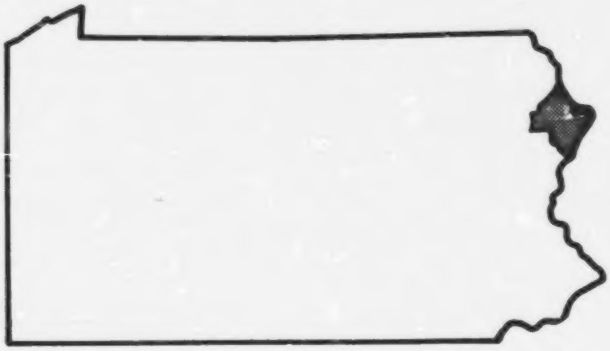
FEM 1.209:421969

24

5M-C-38

FLOOD INSURANCE STUDY

TOWNSHIP OF SHOHOLA, PENNSYLVANIA
PIKE COUNTY



JULY 15, 1988

COMPLETED

Federal Emergency Management Agency

COMMUNITY NUMBER - 421969

ORIGINAL

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

TABLE OF CONTENTS

1.0 INTRODUCTION 1

  1.1 Purpose of Study 1

  1.2 Authority and Acknowledgments 1

  1.3 Coordination 1

2.0 AREA STUDIED 2

  2.1 Scope of Study 2

  2.2 Community Description 2

  2.3 Principal Flood Problems 4

  2.4 Flood Protection Measures 4

3.0 ENGINEERING METHODS 4

  3.1 Hydrologic Analyses 5

  3.2 Hydraulic Analyses 6

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS 7

  4.1 Floodplain Boundaries 7

  4.2 Floodways 15

5.0 INSURANCE APPLICATIONS 17

6.0 FLOOD INSURANCE RATE MAP 19

7.0 OTHER STUDIES 19

8.0 LOCATION OF DATA 19

9.0 BIBLIOGRAPHY AND REFERENCES 20

TABLE OF CONTENTS - continued

FIGURES

Figure 1 - Vicinity Map 3

Figure 2 - Floodway Schematic 17

TABLES

Table 1 - Summary of Discharges 5 - 6

Table 2 - Regulatory Data 8 - 14

Table 3 - Floodway Data 16

EXHIBITS

Exhibit 1 - Flood Profiles
- Balliard Creek Panel 01P
- Grassy Brook Panels 02P-03P
- Panther Creek Panels 04P-06P
- Shohola Creek Panels 07P-17P
- Twin Lakes Creek Panels 18P-20P
- Walker Lake Creek Panels 21P-22P
- Delaware River Panels 23P-24P

Exhibit 2 - Flood Insurance Rate Map Index and Street Index
Flood Insurance Rate Map

Exhibit 3 - Elevation Reference Marks

FLOOD INSURANCE STUDY
TOWNSHIP OF SHOHOLA, PIKE COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Shohola, Pike County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for Indian Orchard Brook were prepared by the Philadelphia District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 16. The hydrologic and hydraulic analyses for the Delaware River were prepared by the Delaware River Basin Commission (DRBC) during the preparation for the Flood Insurance Study for the Town of Highland, New York. The work for this study was completed in April 1987.

1.3 Coordination

An initial Consultation and Coordination Officer's (CCO) meeting was held in December 1984 with representatives of FEMA and the township to identify the streams to be studied by detailed methods. A search for basic data was made at all levels of government. Maps were obtained from the community and the U. S. Geological Survey (USGS). On September 2, 1987, a final CCO meeting was held with representatives of FEMA, the township, and the COE (the study contractor) to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Shohola, Pike County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: Balliard Creek, from its confluence with Shohola Creek to Shohola Falls Road; Grassy Brook, from its confluence with Shohola Creek to a point approximately 1,600 feet upstream; Panther Creek, from its confluence with the Delaware River to Panther Brook Road; Shohola Creek, from a point approximately 1.8 miles above confluence with Delaware River to a point approximately 280 feet upstream of the confluence of Balliard Creek; Twin Lakes Creek, from Twin Lakes Road to a point approximately 0.61 mile upstream; Walker Lake Creek, from Seneca Road to a point approximately 1,600 feet upstream; and the Delaware River, from a point approximately 1.02 mile downstream from its confluence with Shohola Creek to the upstream corporate limits. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through April 1992.

Portions of Balliard Creek, Shohola Creek, and the Delaware River were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Shohola.

2.2 Community Description

The Township of Shohola is located in northeastern Pike County, covering an area of approximately 29,000 square acres. It is bordered by the Towns of Highland and Lumberland, New York, to the north; the Township of Westfall to the east; the Townships of Milford, Dingman, and Blooming Grove to the south; and the Township of Lackawaxen to the west. Shohola had a population of 1,075 in 1982. It is a second class township governed by a three member Board of Supervisors.

The streams studied in the township flow in a northern direction. The terrain through which the streams travel varies from broad, flat floodplains in the vicinity of minor tributaries and some residential development, to steep slopes, especially along the Delaware River.

The topography of the area varies from moderately hilly terrain to steep mountainous slopes, along with scattered swampy areas and numerous mountain streams. There are scattered residential developments within the township, with the largest developments located in the central portions of Shohola near Walker Lake. Of the

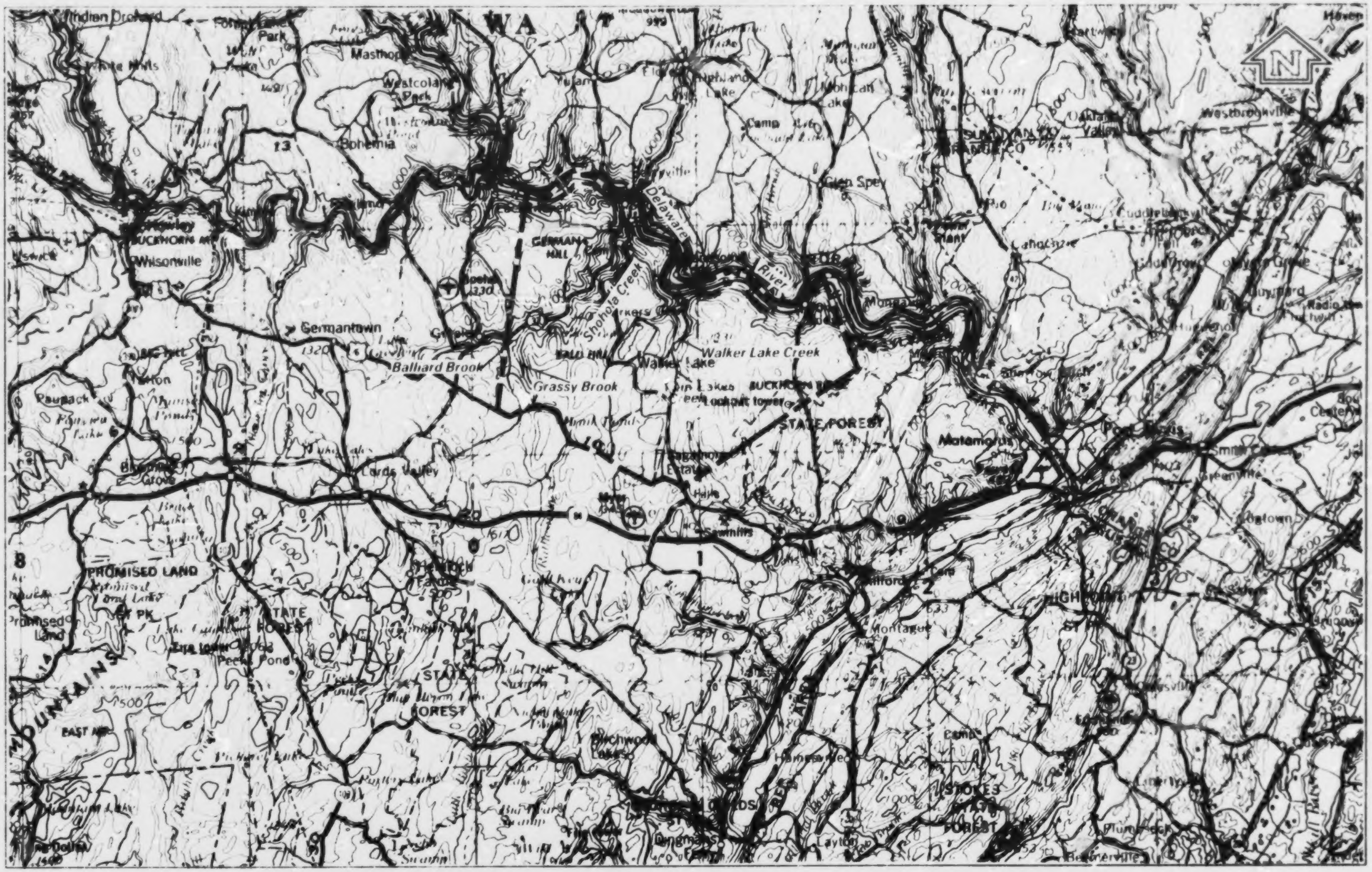

Shohola Creek
Delaware River
Walker Lake
Walker Lake Creek
Grassy Brook
Ballard Brook
Germantown
Bohemia
Westcolang Park
Glen Spey
Matamoras
Port Jervis
Milford
Montague
Promised Land
Lords Valley
Whisonville
Bushkill
STATE FOREST
STOKES STATE FOREST
MOUNTAINS
Westbrookville
Layton
N

FIGURE 1	FEDERAL EMERGENCY MANAGEMENT AGENCY **TOWNSHIP OF SHOHOLA, PA** (PIKE CO.)	APPROXIMATE SCALE 4 0 4 8 12 MILES **VICINITY MAP**

3

total land acreage within the township, approximately 3 percent (806 acres) are owned by the Bureau of Forestry and approximately 27 percent (7,736 acres) are owned by the Game Commission.

The climate in this geographic area is characterized by temperatures ranging from an average high of 68 degrees Fahrenheit (°F) in summer to an average low of 30°F in winter. The average annual rainfall for the region is 44 inches.

2.3 Principal Flood Problems

The principal flood problems in the Township of Shohola are associated with Balliard Creek, Grassy Brook, Panther Creek, Shohola Creek, Twin Lakes Creek, Walker Lake Creek, and the Delaware River. A review of newspaper accounts reveals that little information concerning flood damage within the township is available. Severe flooding occurred in October 1903, May 1942, and August 1955; however, extensive physical damage and loss of life in the surrounding area overshadowed flooding on streams within the township.

2.4 Flood Protection Measures

New York City has several water-supply reservoirs in the Delaware River basin. These reservoirs significantly retard floodwaters along the Delaware River even though they were not originally intended as flood control structures. The Cannonsville Reservoir near Cannonsville, New York, and the Pepacton Reservoir near Downsville, New York, are two New York City reservoirs that have helped reduce flooding along the Delaware River since their construction in 1963 and 1964, respectively. Discharges on the Delaware River are also regulated by Prompton, Jadwin, and Wallenpaupack Reservoirs, which are located in Pennsylvania on tributaries to the Delaware River.

There are no local flood protection measures on any of the other streams within the Township of Shohola. Residents of the community depend on the usual warnings issued through radio, television, and local newspapers for information concerning possible flood conditions. Flood warnings and predicted flood peaks are issued by the National Oceanic and Atmospheric Administration Flood Forecasting Centers located at Harrisburg, Pennsylvania, and Trenton, New Jersey.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The hydrologic analysis for the Delaware River was obtained from the Flood Insurance Study for the Town of Highland, New York (Reference 1).

All USGS stream gages with a reasonable number of years of record in Monroe, Wayne, Pike, and nearby counties were analyzed. The methodology described in Bulletin 17B was used to develop 100-year discharges for Balliard Creek, Grassy Brook, Panther Creek, Shohola Creek, Twin Lakes Creek, and Walker Lake Creek (Reference 2). A regional curve showing drainage area versus 100-year flood discharge was then generated using the results of the statistical analysis. Data from this curve were applied to the detailed streams.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGE (cfs) 100-YEAR
BALLIARD CREEK		
At confluence with Shohola Creek	11.4	1,625
GRASSY BROOK		
At confluence with Shohola Creek	1.8	265
PANTHER CREEK		
At confluence with Delaware River	3.9	570

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGE (cfs) 100-YEAR
SHOHOLA CREEK		
At downstream limit of detailed study	85.0	11,610
Upstream of confluence with Balliard Creek	72.0	9,900
TWIN LAKES CREEK		
At downstream limit of detailed study	2.9	425
WALKER LAKE CREEK		
At downstream limit of detailed study	3.3	480
DELAWARE RIVER		
At USGS gage at Port Jervis, New York, (No. 01434000)	3,076	170,000*
At USGS gage near Barryville, New York, (No. 01428500)	2,025	150,000*

*Regulated annual peak discharge from the DRBC

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis for the streams studied by detailed methods were photogrammetric and/or field surveyed and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures (Reference 3). The ground control for the photogrammetry was acquired using inertial surveying techniques (Reference 4).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations for the Delaware River were obtained from the Flood Insurance Study for the Town of Highland, New York (Reference 1). Water-surface elevations of floods of the selected recurrence intervals for the remaining streams studied by detailed methods were computed using the COE HEC-2 step-backwater computer program (Reference 5). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. The starting water-surface elevation for the Delaware River was calculated by the slope/area method. The starting water-surface elevations for the remaining streams studied by detailed methods were obtained from backwater computations of their respective main stems or from normal depth computations, as appropriate. The results of the water-surface elevations for the streams studied by detailed methods except the Delaware River are tabulated for selected cross sections (Table 2).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the stream and floodplain areas (Reference 6). For the Delaware River, the channel "n" values ranged from 0.034 to 0.037, and the overbank "n" values ranged from 0.040 to 0.090. The roughness values for the remaining streams studied by detailed methods ranged from 0.045 in the main channel to 0.090 in the overbank area.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 7).

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A	850	25	610	7.1	25	110	2.2	150	910	2.7	923.3

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Shohola
Pike County
Pennsylvania

REGULATORY DATA

Balliard Creek

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A	550	15	180	7.2	5	10	2.2	40	70	2.3	914.0
B	1600	15	250	7.6	5	10	2.3	10	20	2.4	964.9

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Shohola
Pike County
Pennsylvania

REGULATORY DATA

Grassy Brook

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A (1)	200	60	(2)	(2)	65	(2)	(2)	10	(2)	(2)	594.6
B	1000	50	520	7.0	95	50	0.9	5	10	2.1	616.9
C	1535	20	550	7.4	70	60	1.7	45	100	2.7	630.5
D	2120	55	540	7.7	50	10	1.2	5	20	2.0	651.4
E	2400	50	420	7.2	0	0	0.0	150	100	2.5	660.9

(1) Topwidth adjusted due to backwater from the Delaware River.

(2) Data not available due to topwidth adjustment.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Shohola
Pike County
Pennsylvania

REGULATORY DATA

Panther Creek

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A	900	70	6160	11.5	550	2990	2.8	150	2470	3.9	687.3
B	2400	55	4040	9.9	1400	6990	2.7	80	580	2.7	698.7
C	4000	80	5950	12.7	655	4800	4.1	70	860	4.1	713.6
D	6775	95	8940	12.2	45	740	4.0	150	1930	3.6	766.2 5/6 4
E	8525	135	8870	11.6	70	850	4.2	85	1890	5.0	756.3
F	9675	45	5870	16.0	235	5460	5.4	15	290	4.7	775.2
G	11270	65	5950	11.3	105	2500	4.5	105	3160	4.9	792.3
H	11950	125	9440	9.0	65	970	3.3	50	1200	3.8	796.3
I	13625	35	4670	17.2	15	330	5.1	235	6610	6.1	811.1
J	14875	80	9420	11.7	65	1870	4.5	20	320	3.4	822.7
K	16290	90	10070	15.4	45	1200	6.1	20	340	4.7	834.9

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Shohola
Pike County
Pennsylvania

REGULATORY DATA

Shohola Creek

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
L	18160	100	7170	9.9	425	3540	2.9	60	910	3.6	855.3
M	20400	80	9410	11.2	85	1260	3.3	45	940	3.6	867.2
N	21450	105	9540	9.2	20	320	2.8	170	1750	2.7	872.2
O	23210	65	7860	13.9	285	3090	3.6	30	660	4.5	881.7
P	24950	80	8570	12.5	30	240	3.0	395	2800	2.9	891.8
Q	26575	45	7750	14.2	35	1370	5.3	165	2490	3.8	903.6
R	27675	110	9810	7.5	120	1660	2.4	20	140	1.7	908.7
S	28770	100	7760	8.1	375	3060	2.3	90	790	2.2	916.3

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Shohola
Pike County
Pennsylvania

REGULATORY DATA

Shohola Creek (con't)

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A	1125	45	330	6.1	30	30	1.9	50	60	1.9	1290.3
B	2675	20	300	7.4	25	60	2.4	30	70	2.3	1328.6

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Shohola
Pike County
Pennsylvania

REGULATORY DATA

Twin Lakes Creek

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A	675	10	310	6.7	15	80	2.7	55	90	1.6	1182.9
B	1600	20	390	6.2	30	70	2.3	5	20	2.5	1202.6
C	2000	70	460	6.1	0	0	0.0	0	0	0.0	1213.6

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Shohola
Pike County
Pennsylvania

REGULATORY DATA

Walker Lake Creek

For the streams studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for the Township of Shohola (Reference 8).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 3). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

No floodways were calculated as part of this study; the floodway for the Delaware River was obtained from the Flood Insurance Study for the Town of Highland, New York (Reference 1). Portions of the floodway widths for the Delaware River extend beyond the corporate limits.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the

BLANK PAGE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)[2]	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Delaware River								
A	0	440/180	11,630	13.9	577.4	577.4	578.2	0.8
B	835	656/306	18,144	8.9	580.2	580.2	580.7	0.5
C	1,855	539/309	15,035	10.8	580.8	580.8	581.2	0.4
D	3,080	488/238	12,546	12.9	581.7	581.7	582.2	0.5
E	4,195	484/254	11,740	13.8	583.5	583.5	583.8	0.3
F	5,080	425/165	10,796	15.0	585.0	585.0	585.1	0.1
G	5,930	665/275	14,899	10.9	588.0	588.0	588.2	0.2
H	6,400	650/290	14,709	11.0	588.8	588.8	588.8	0.0
I	6,880	660/345	17,423	9.3	589.5	589.5	589.8	0.3
J	7,415	572/257	16,246	10.0	589.8	589.8	590.1	0.3
K	8,130	518/218	14,057	11.5	590.2	590.2	590.5	0.3
L	9,510	555/255	14,260	11.4	591.8	591.8	592.1	0.3
M	10,760	643/383	15,740	10.3	593.4	593.4	593.7	0.3
N	11,530	505/245	12,018	13.5	593.9	593.9	594.1	0.2
O	12,500	594/274	13,871	11.7	595.9	595.9	596.2	0.3
P	13,445	611/321	14,960	10.8	597.4	597.4	597.6	0.2
Q	14,510	510/240	13,418	12.1	598.4	598.4	598.6	0.2
R	15,600	400/220	9,887	16.4	599.4	599.4	599.5	0.1
S	16,700	689/330	16,360	9.9	603.8	603.8	603.9	0.1
T	17,980	444/214	12,306	13.2	604.6	604.6	604.7	0.1
U	19,240	449/229	11,878	13.6	605.9	605.9	606.5	0.6
V	20,230	674/284	17,144	9.5	608.5	608.5	609.1	0.6
W	21,030	610/300	17,922	9.0	609.1	609.1	609.8	0.7
X	21,810	540/280	14,096	11.5	609.3	609.3	610.0	0.7
Y	22,425	478/288	11,732	13.8	609.8	609.8	610.5	0.7

[1] Feet above limit of detailed study

[2] Width/width within corporate limits

TABLE 3

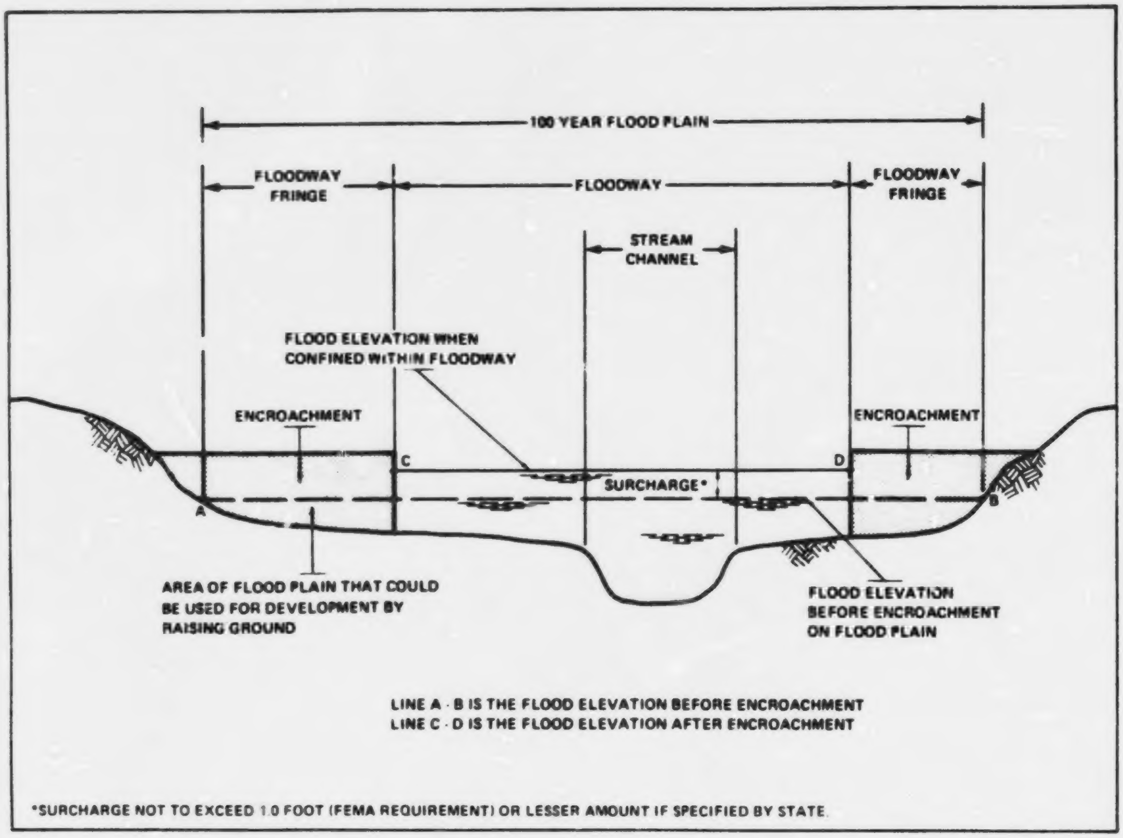
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA.
(PIKE CO.)

FLOODWAY DATA

DELAWARE RIVER

portion of the floodplain that could be completely obstructed without increasing at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN

LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT

*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain,and to areas of 100-year flooding where average depths are less than 1 foot, areas of 10-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.
Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Town of Highland, New York; and the Township of Milford (References 1 and 9). The results of this study are in complete agreement with the results of those studies.

Flood Insurance Studies are currently being prepared for the Townships of Westfall and Lackawaxen (References 10 and 11). The results of those studies will be in complete agreement with the results of this study.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Shohola (Reference 8).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Federal Emergency Management Agency, Flood Insurance Study, Town of Highland, Sullivan County, New York, Washington, D. C., March 4, 1987.

2. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

3. Aerial Data Reduction Associates, Inc., of Pennsauken, New Jersey, Aerial Photogrammetric and Field Surveys of Monroe, Wayne and Pike Counties, Pennsylvania, September 1985 to January 1986.

4. Nortech Surveys (U.S.A.) Inc., Report on the Federal Emergency Management Agency Project, Inertial Elevation Survey For United States Army Corps of Engineers For Aerial Data Reduction Associates Inc., October/November 1985.

5. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, 1982.

6. Ven Te Chow, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

7. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Shohola, Pennsylvania, 1965, Photorevised 1983.

8. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Shohola, Pike County, Pennsylvania, November 30, 1979.

9. Federal Emergency Management Agency, Flood Insurance Study, Township of Milford, Pike County, Pennsylvania, Washington, D. C., December 4, 1985.

10. Federal Emergency Management Agency, Flood Insurance Study, Township of Westfall, Pike County, Pennsylvania (Unpublished).

11. Federal Emergency Management Agency, Flood Insurance Study, Township of Lackawaxen, Pike County, Pennsylvania (Unpublished).

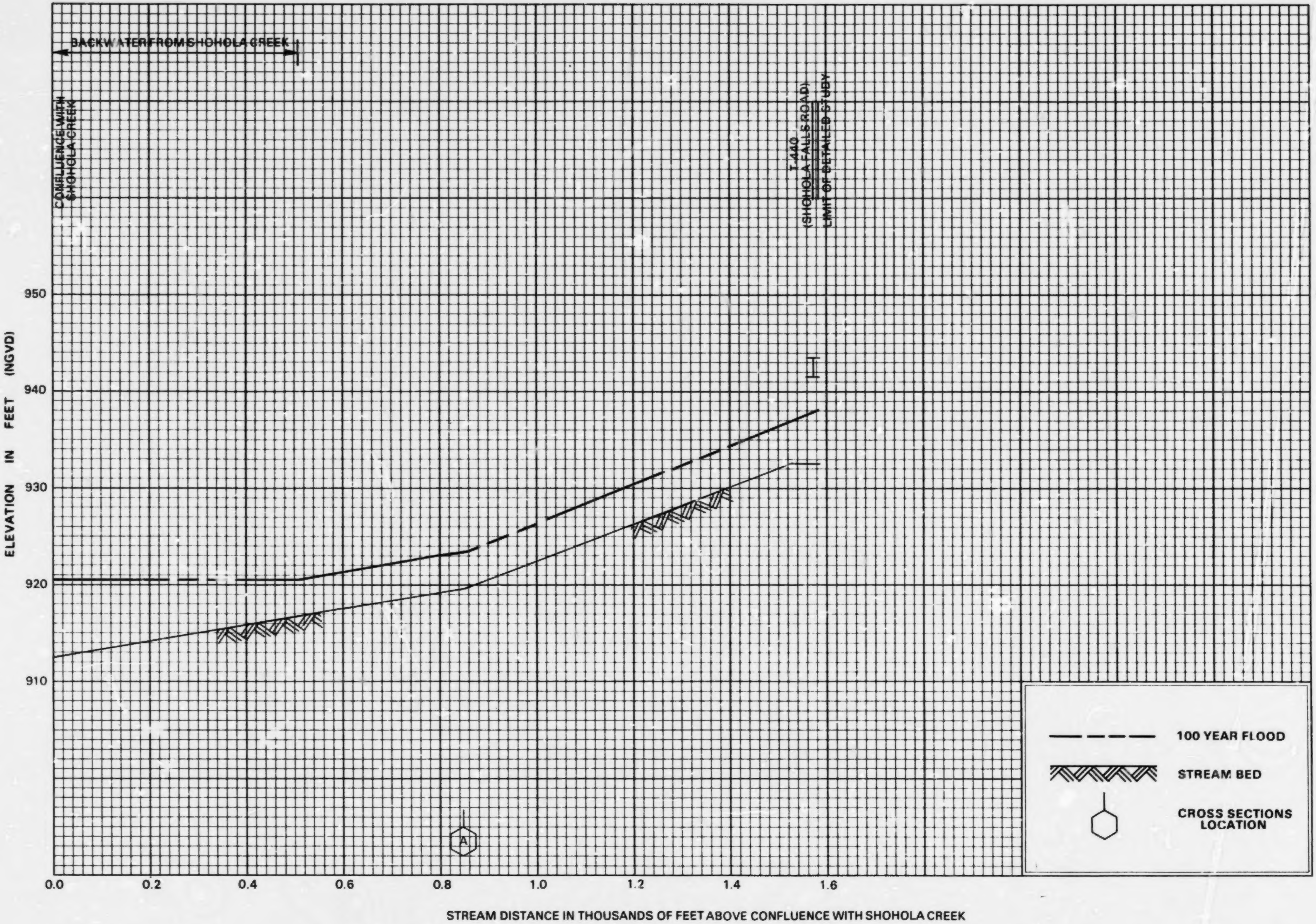
Community Map, General Highway Map, Pike County, Pennsylvania, prepared by the Pennsylvania Department of Transportation, 1981.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	05	650.43	NGS disk stamped M-50 1934 set in rock ledge, 2.1 miles east along CONRAIL tracks from Lackawaxen Station, 60 feet east of milepost 108, 10 feet south of east bound track.
RM 2	05	671.98	T-413 (Panther Brook Road) bridge over Panther Creek. P.K. nail in top of timber deck at north abutment in base of downstream railing.
RM 3	05	674.36	T-413 bridge over Panther Creek Tributary. Square cut in top of downstream bridge wall at center of bridge.
RM 4	05	711.83	Legislative Route 51014 bridge over Shohola Creek. Square cut on corner of downstream bridge wall at northwest abutment.
RM 5	05	1,171.62	Seneca Road bridge over Walker Lake Creek. Painted square in top of concrete deck over center of right pipe at downstream abutment.
RM 6	15	889.02	At downstream access road bridge over Shohola Creek. P.K. nail in top of timber stringer at downstream northeast abutment.
RM 7	15	908.7	At upstream access road bridge over Shohola Creek. P.K. nail in top of timber stringer at downstream north abutment.
RM 8	15	934.42	State Route 434 bridge over Grassy Brook. P.H.D. disk set in top of downstream concrete wing wall at south abutment.
RM 9	15	943.41	Shohola Falls Road bridge over Balliard Creek. Square cut in top of downstream bridge wall over center of arch.
RM 10	20	1,284.21	Legislative Route 51008 (Twin Lakes Road) bridge over Twin Lakes Creek. Painted square in top of downstream end of CMP pipe.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 11	20	1,341.07	Access Road bridge over Twin Lakes Creek. P.K. nail in top of timber deck at downstream northwest abutment.



FLOOD PROFILES

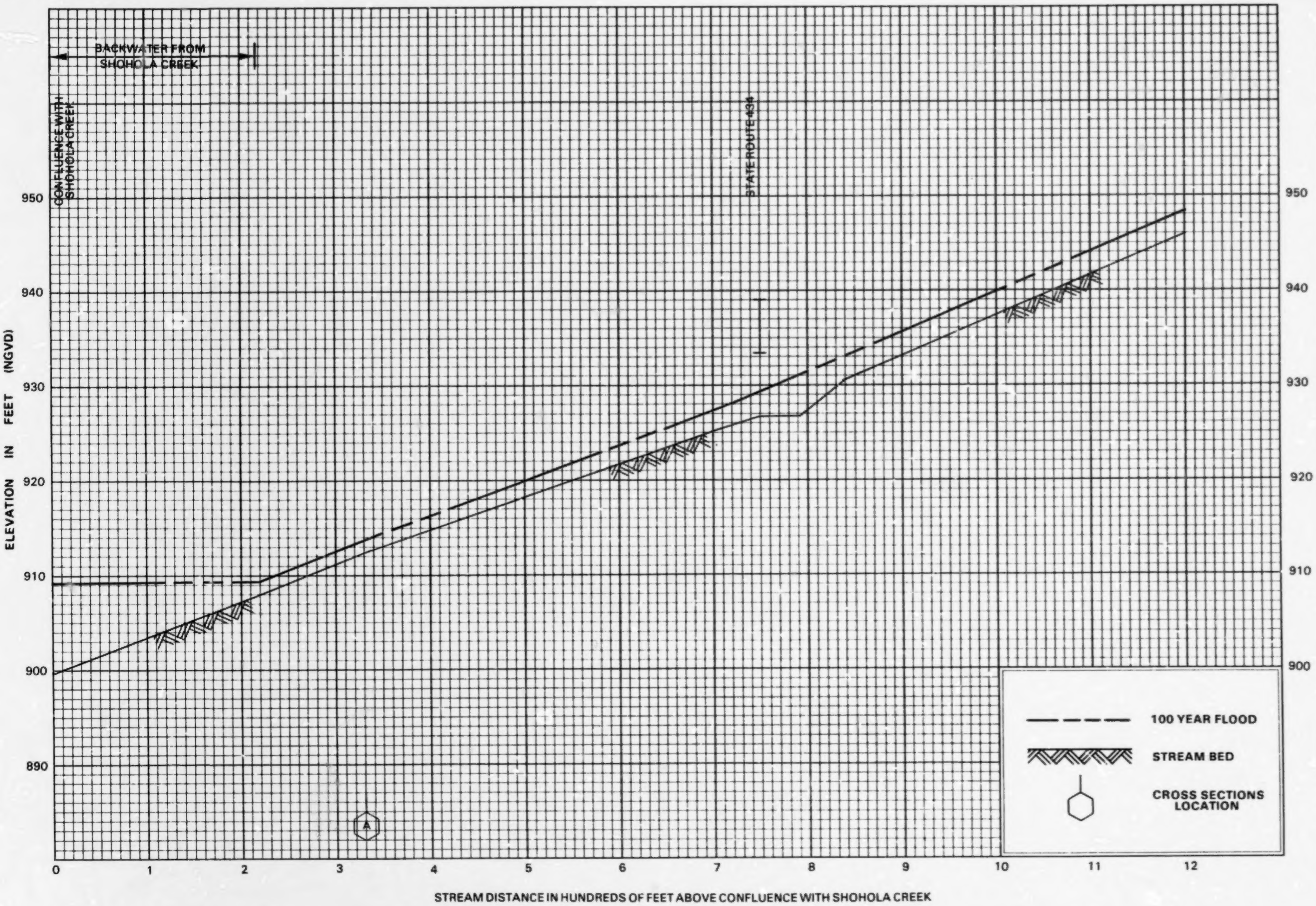
BALLIARD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

01P

23



FLOOD PROFILES

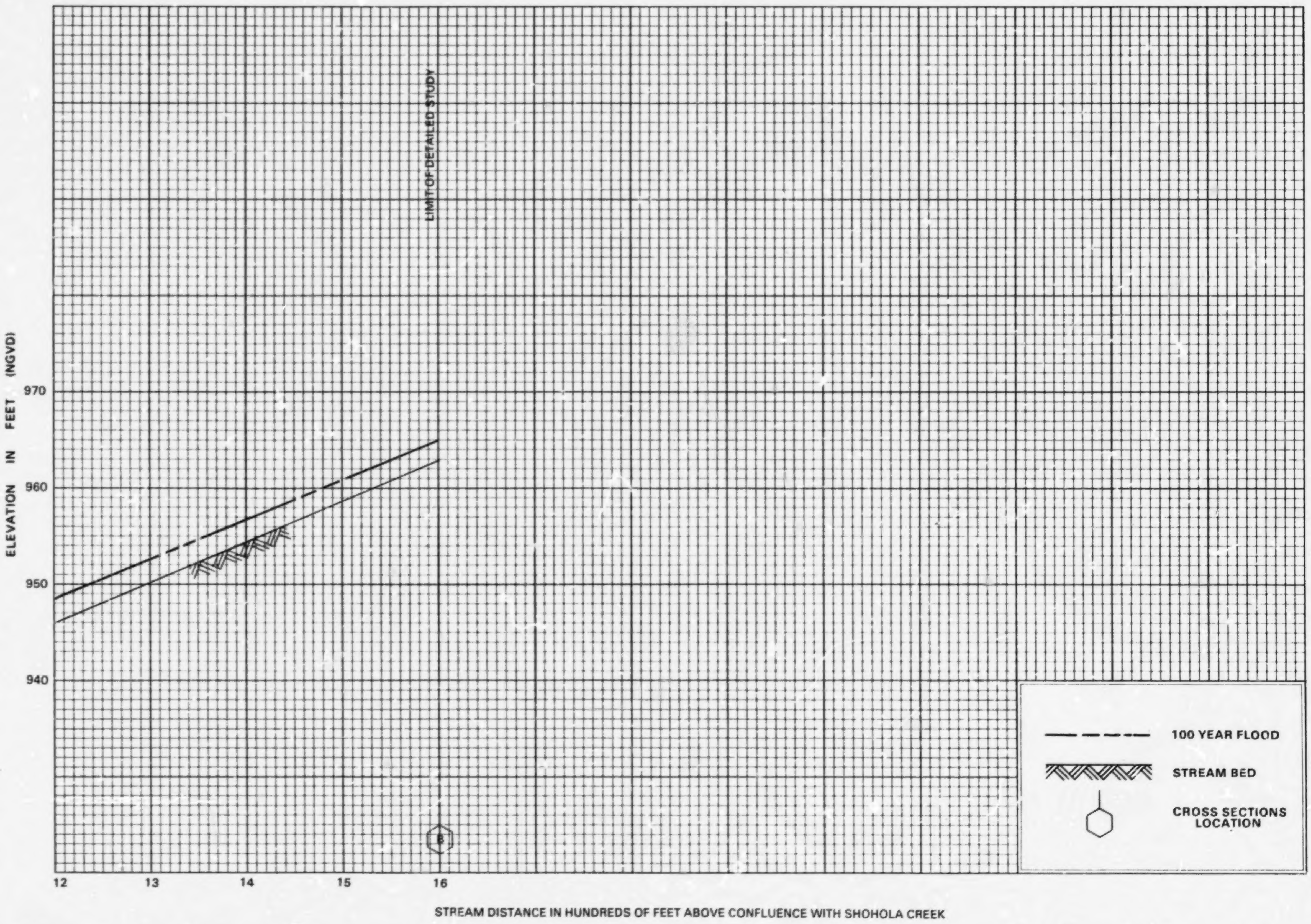
GRASSY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

02P

24



FLOOD PROFILES

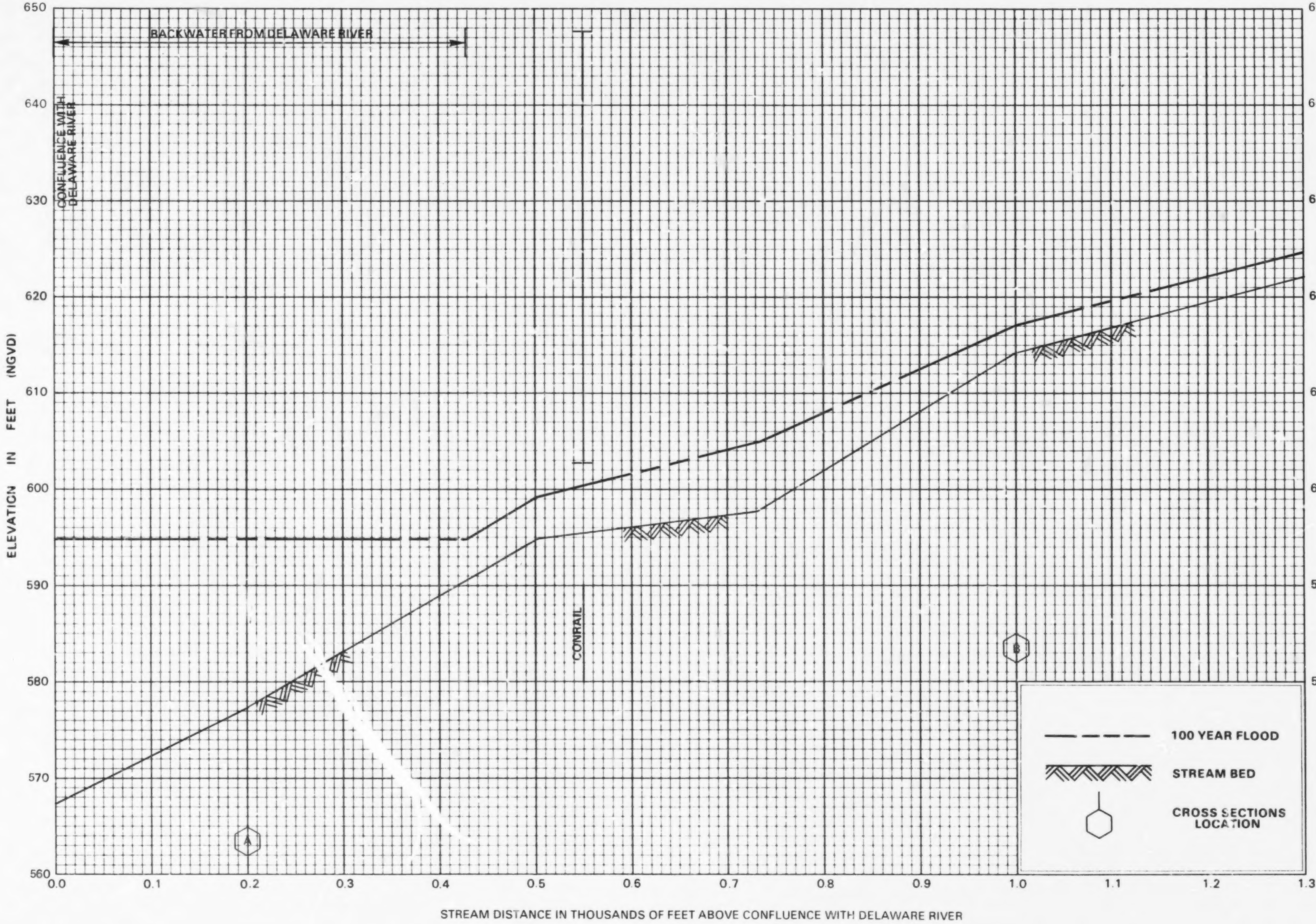
GRASSY BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

03P

25



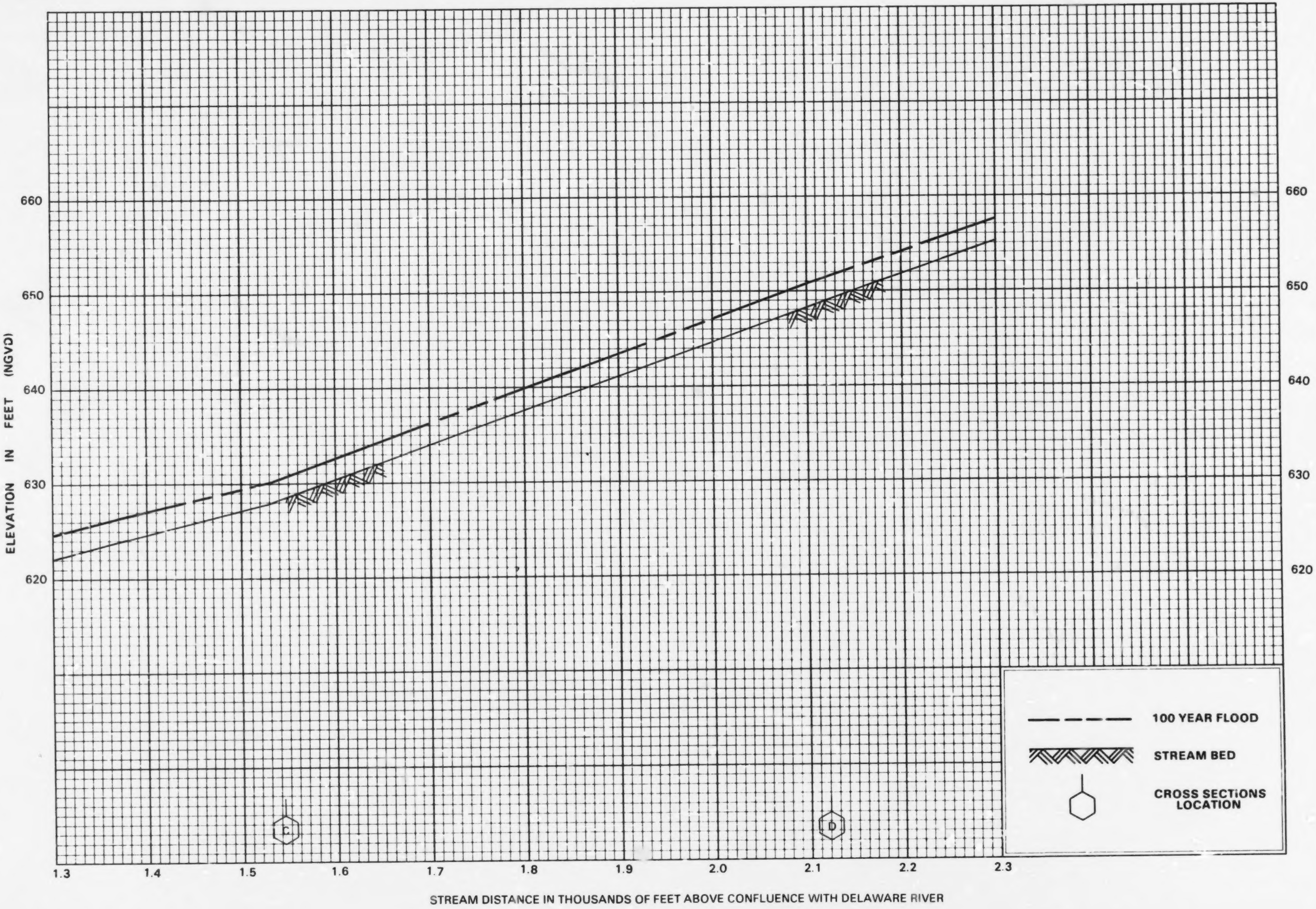
FLOOD PROFILES

PANTHER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

04P



FLOOD PROFILES

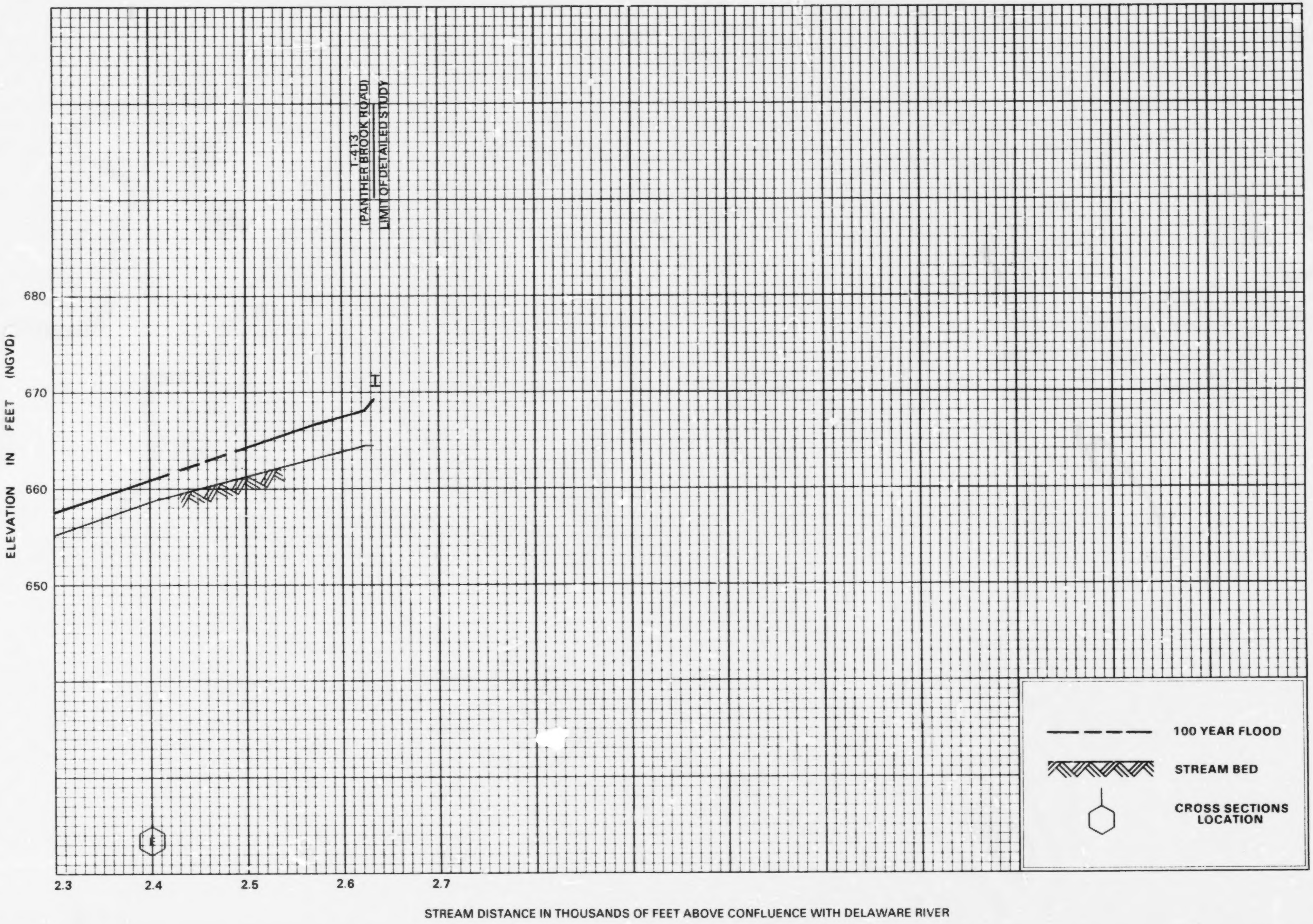
PANTHER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

05P

27



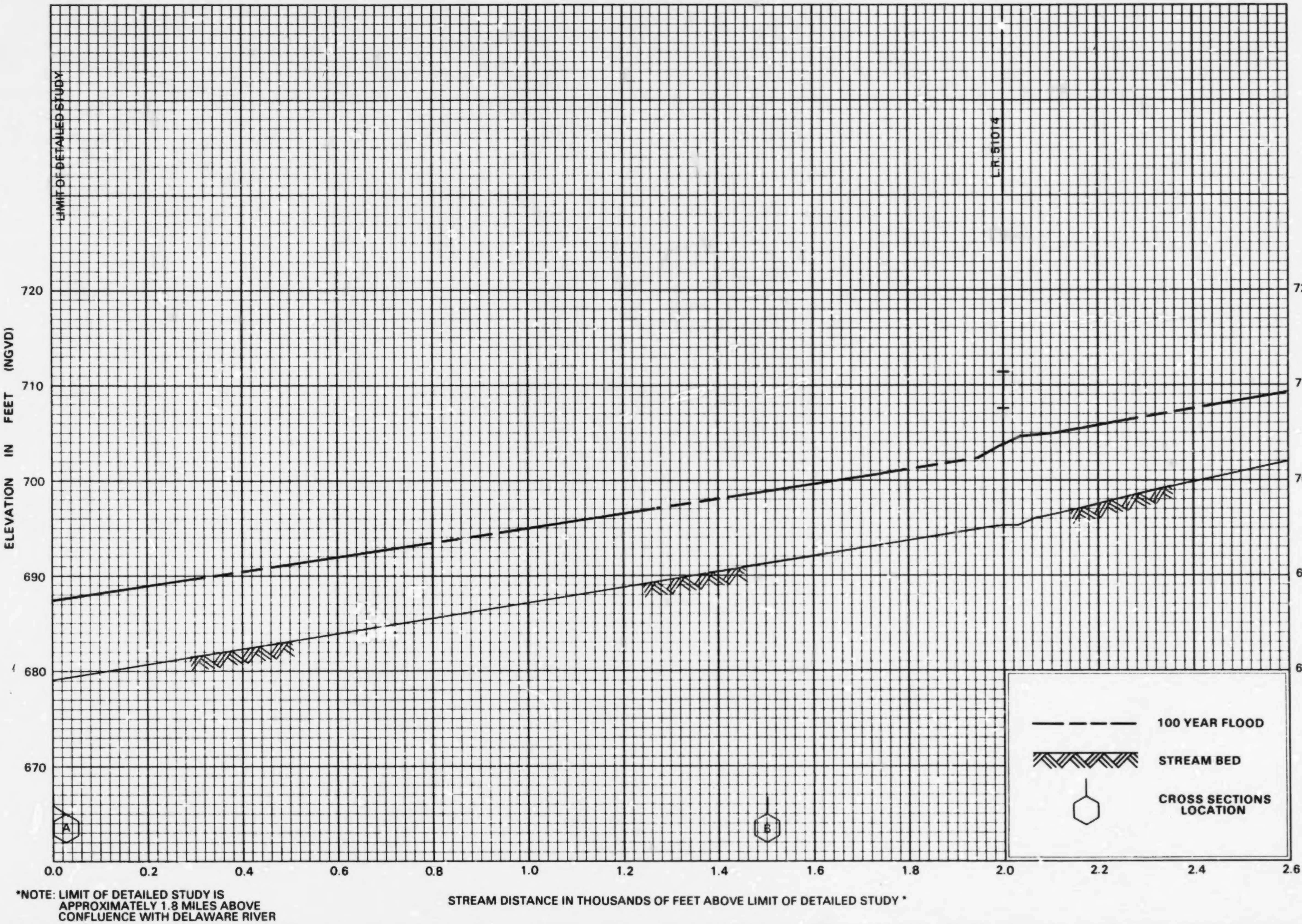
FLOOD PROFILES

PANTHER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

06P



*NOTE: LIMIT OF DETAILED STUDY IS APPROXIMATELY 1.8 MILES ABOVE CONFLUENCE WITH DELAWARE RIVER

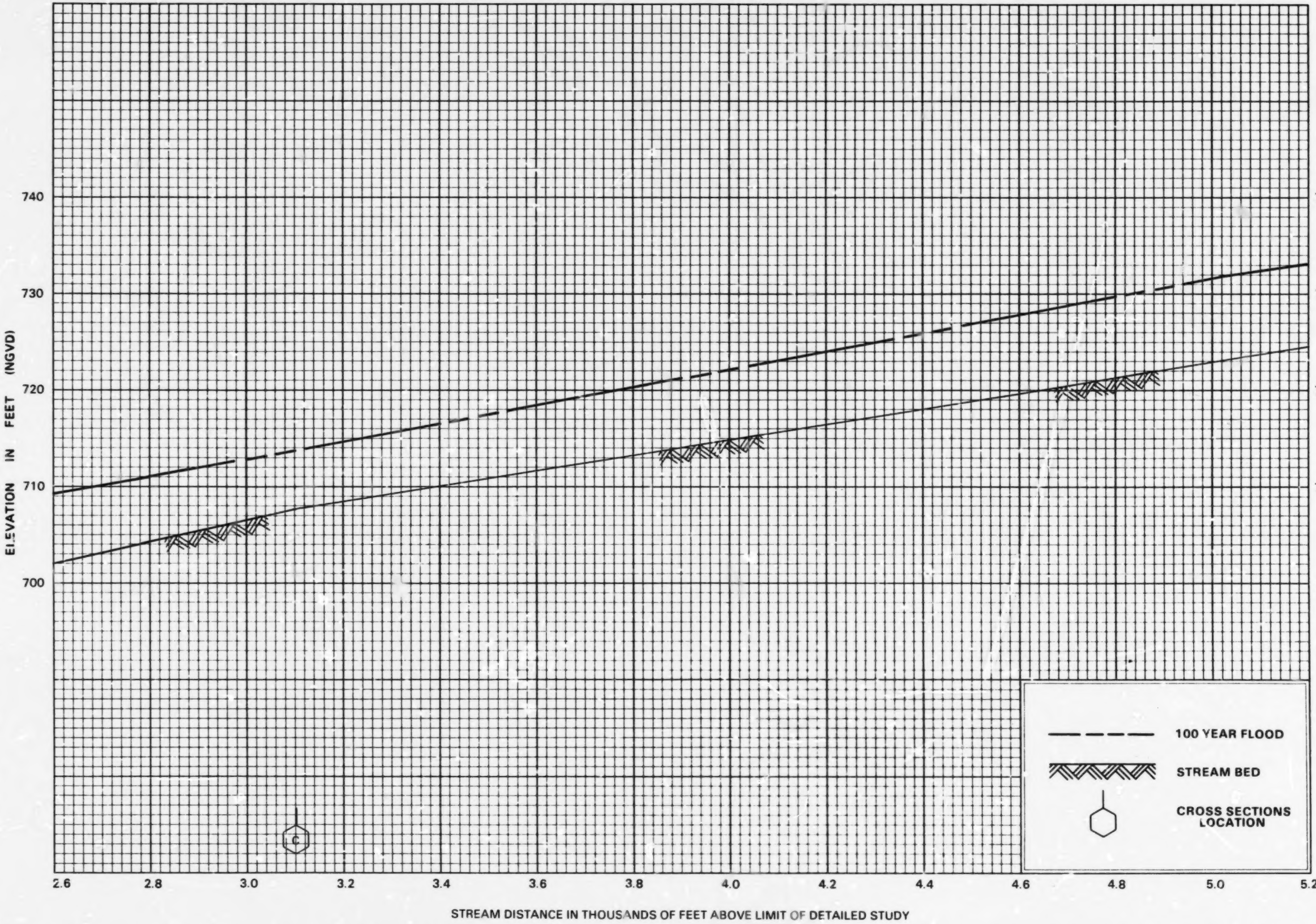
FLOOD PROFILES

SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

07P



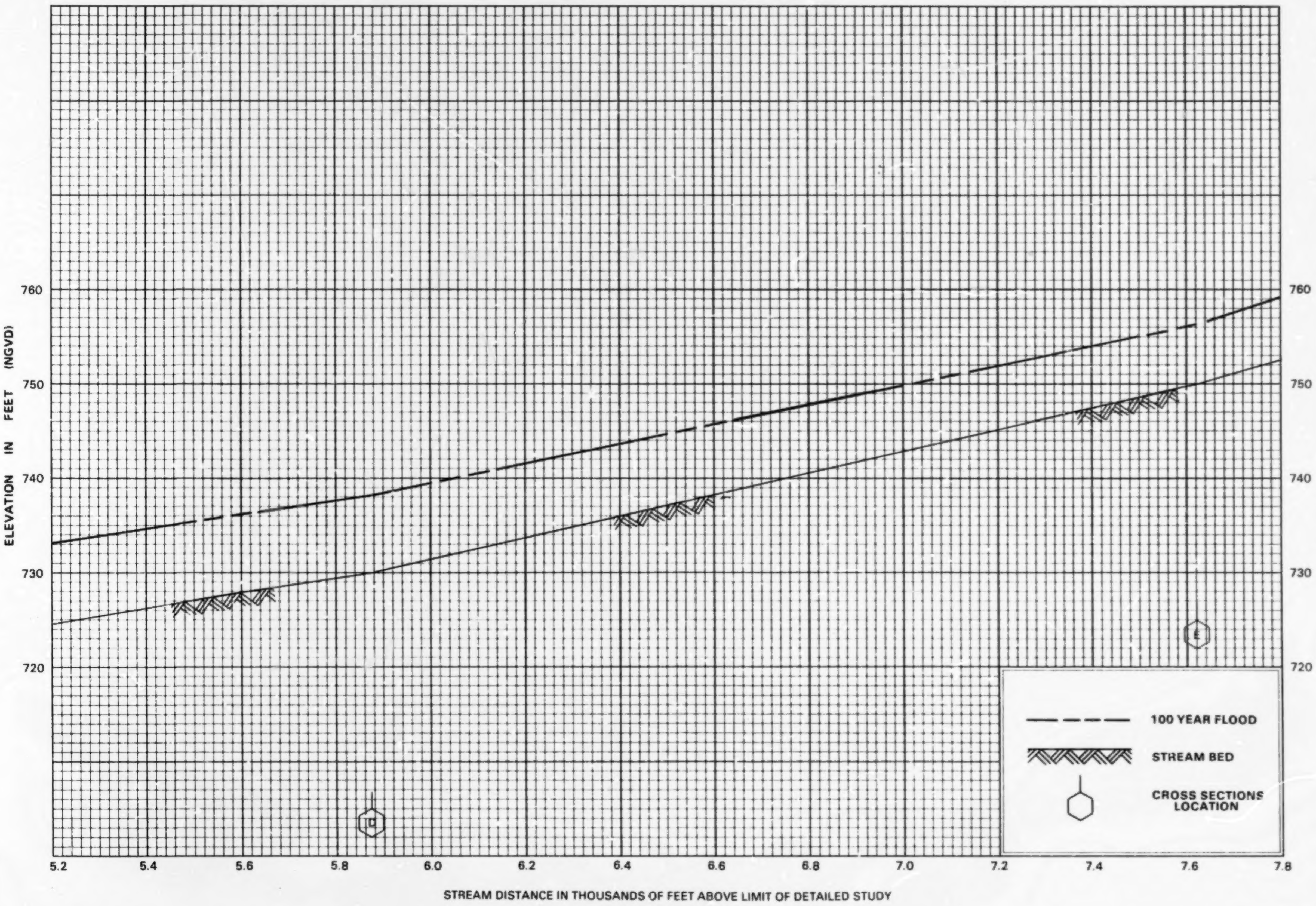
FLOOD PROFILES

SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

08P



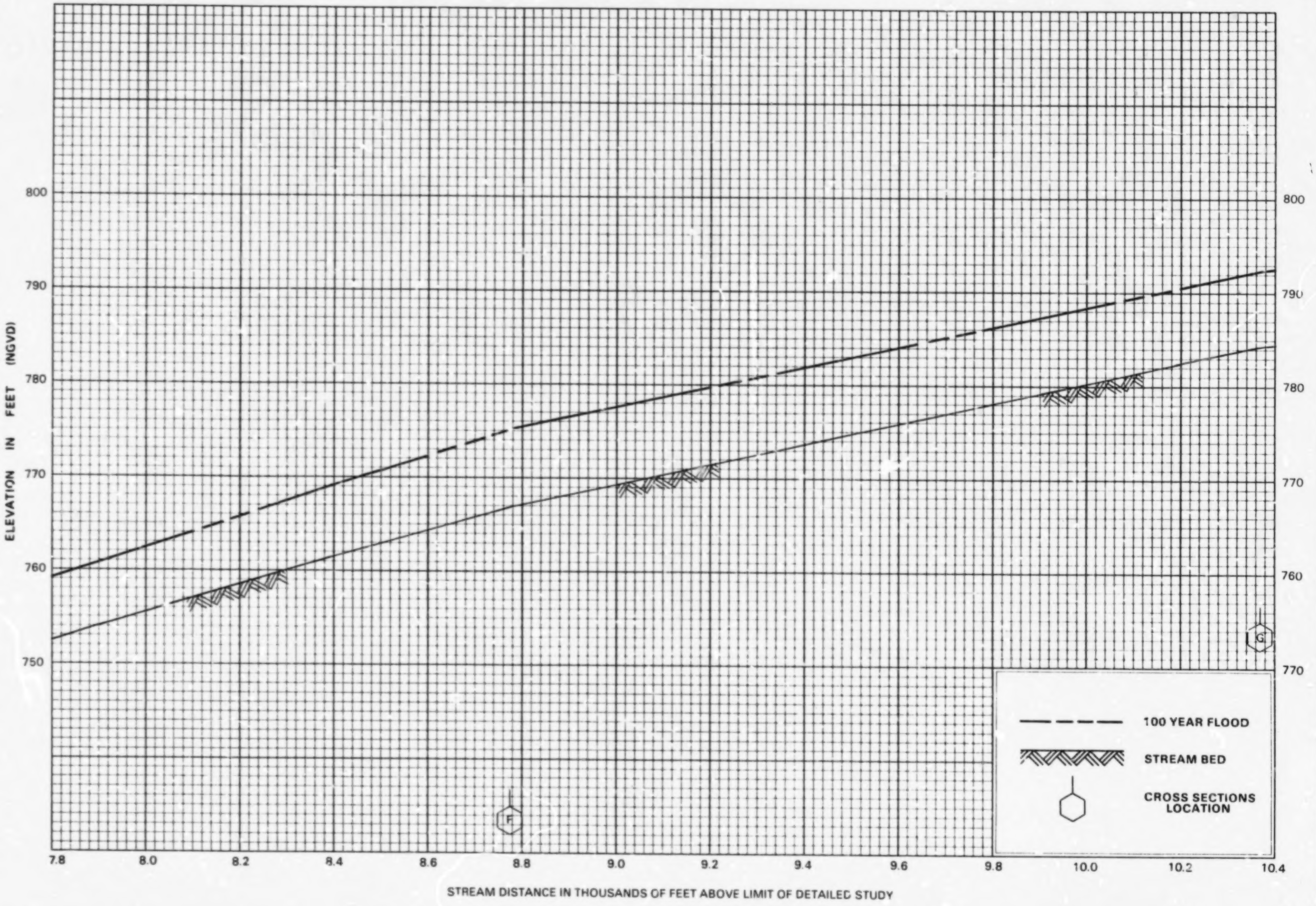
FLOOD PROFILES

SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

09P



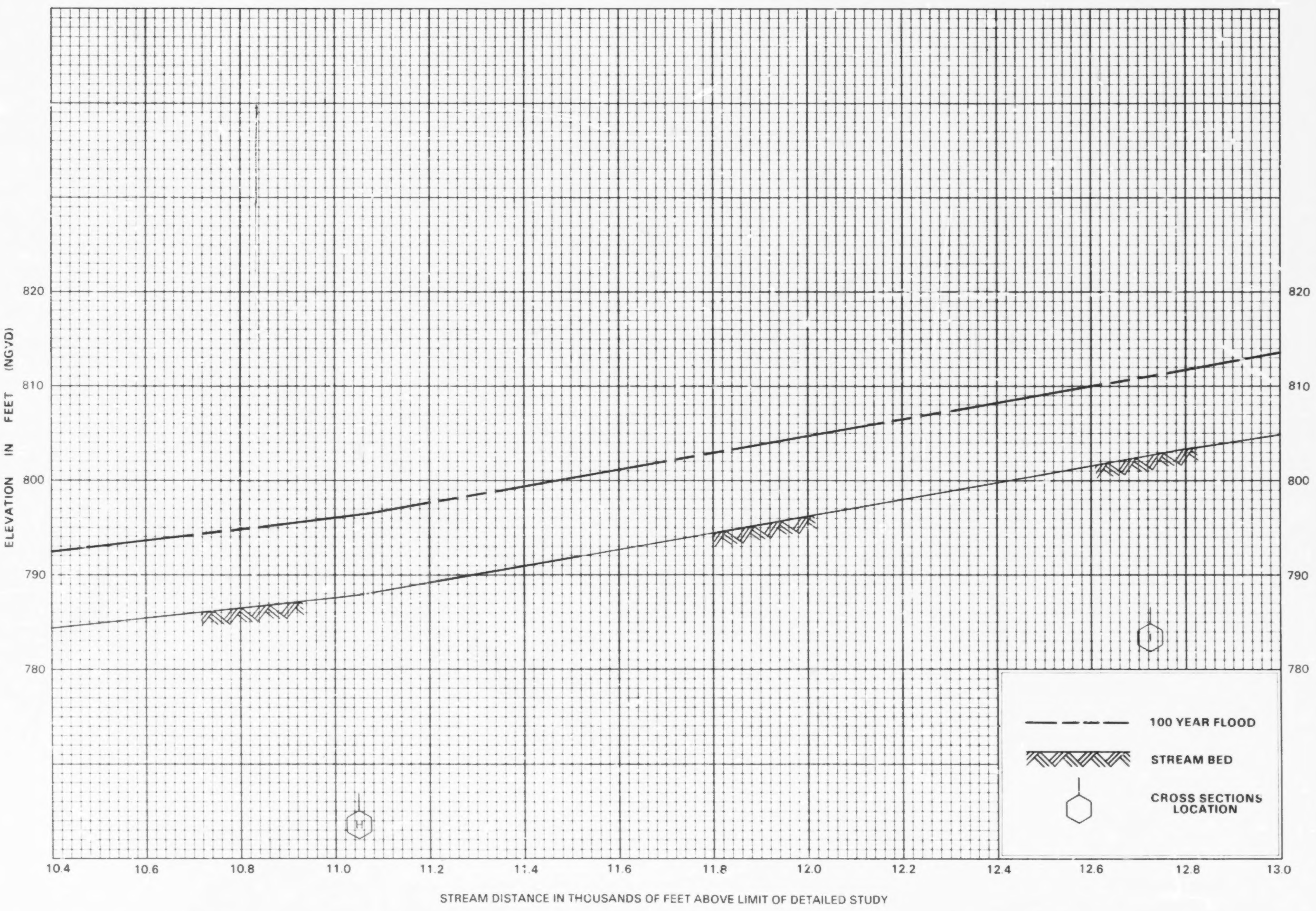
FLOOD PROFILES

SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

10P



FLOOD PROFILES

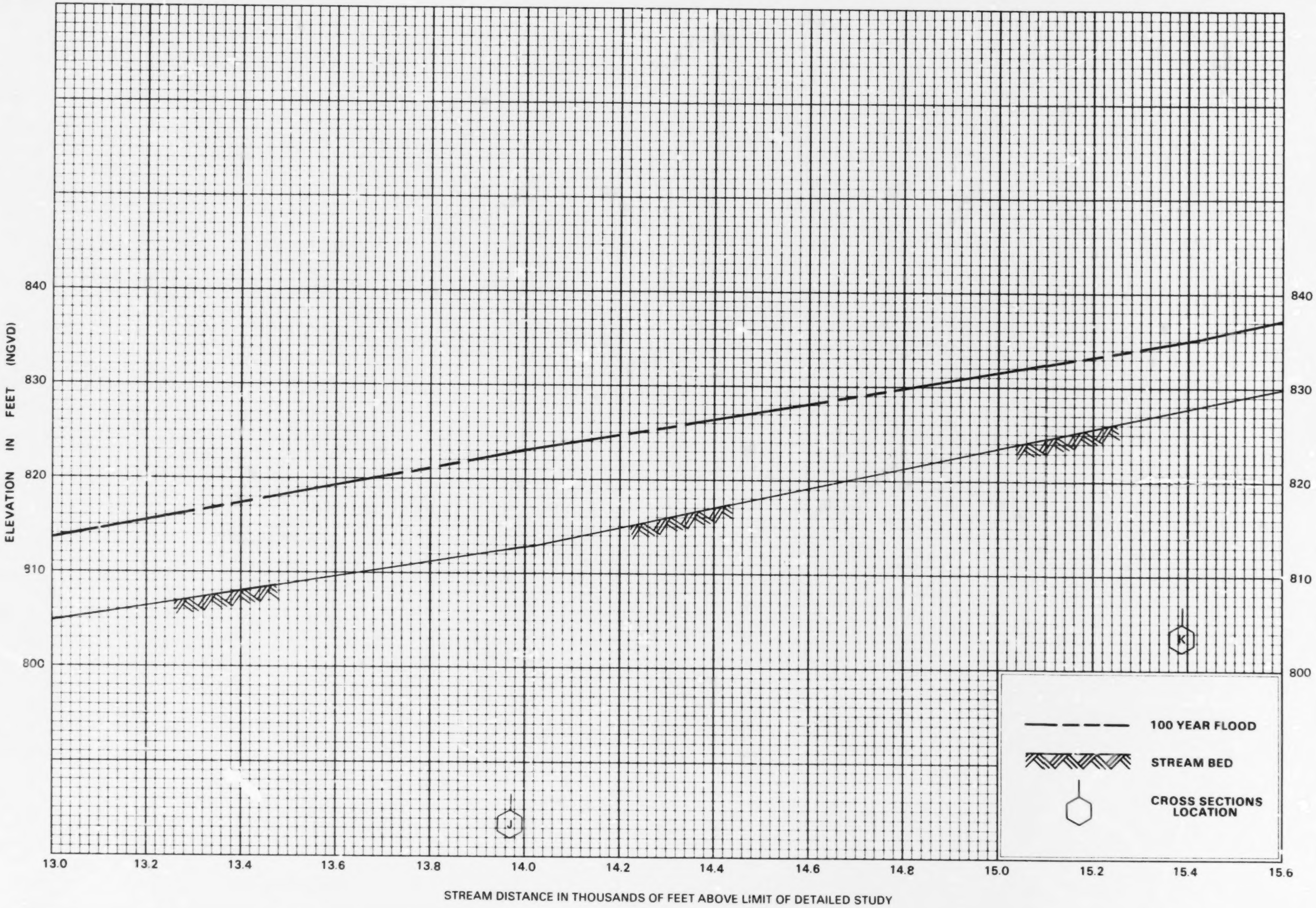
SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA

(PIKE CO.)

11P



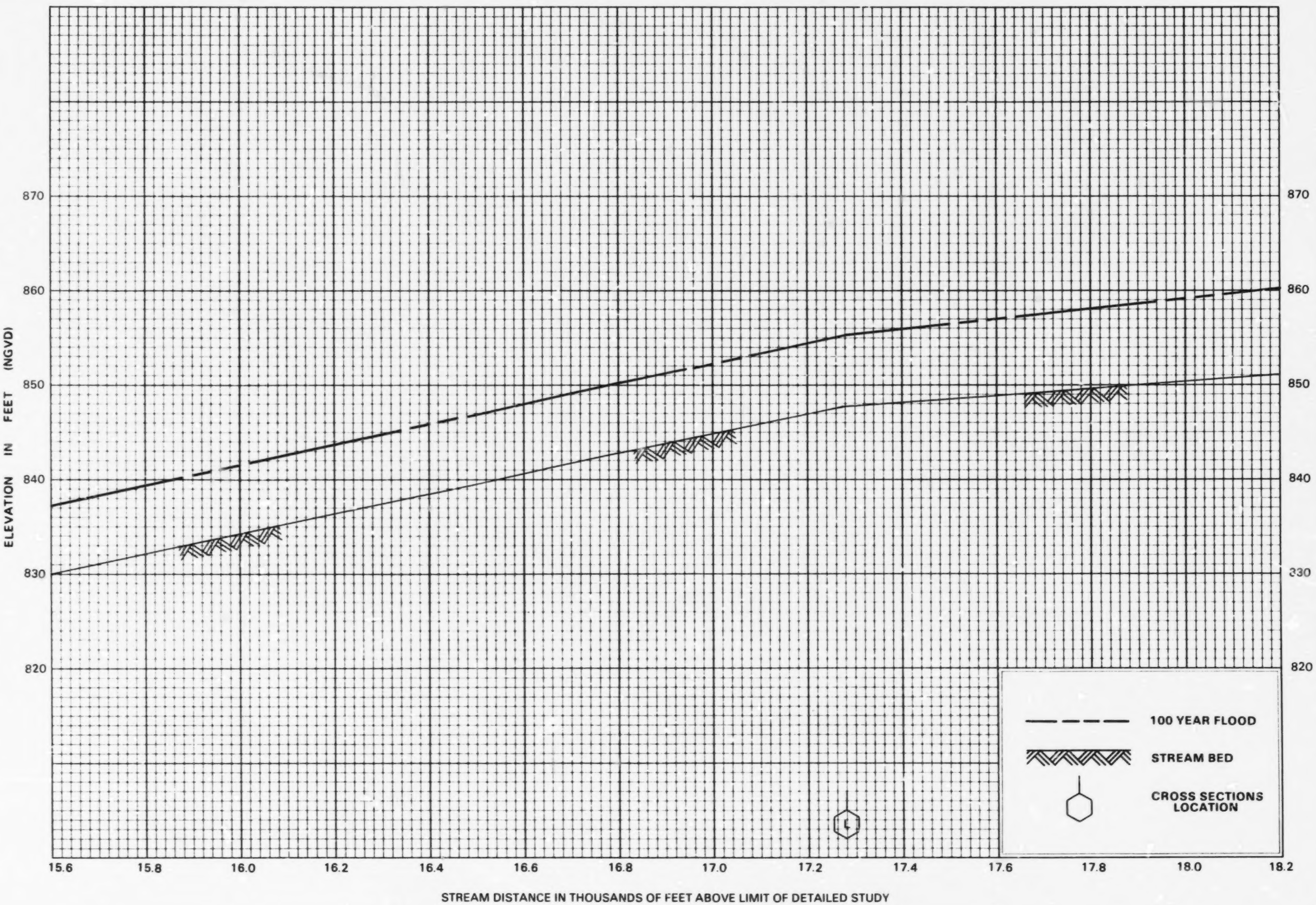
FLOOD PROFILES

SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

12P



FLOOD PROFILES

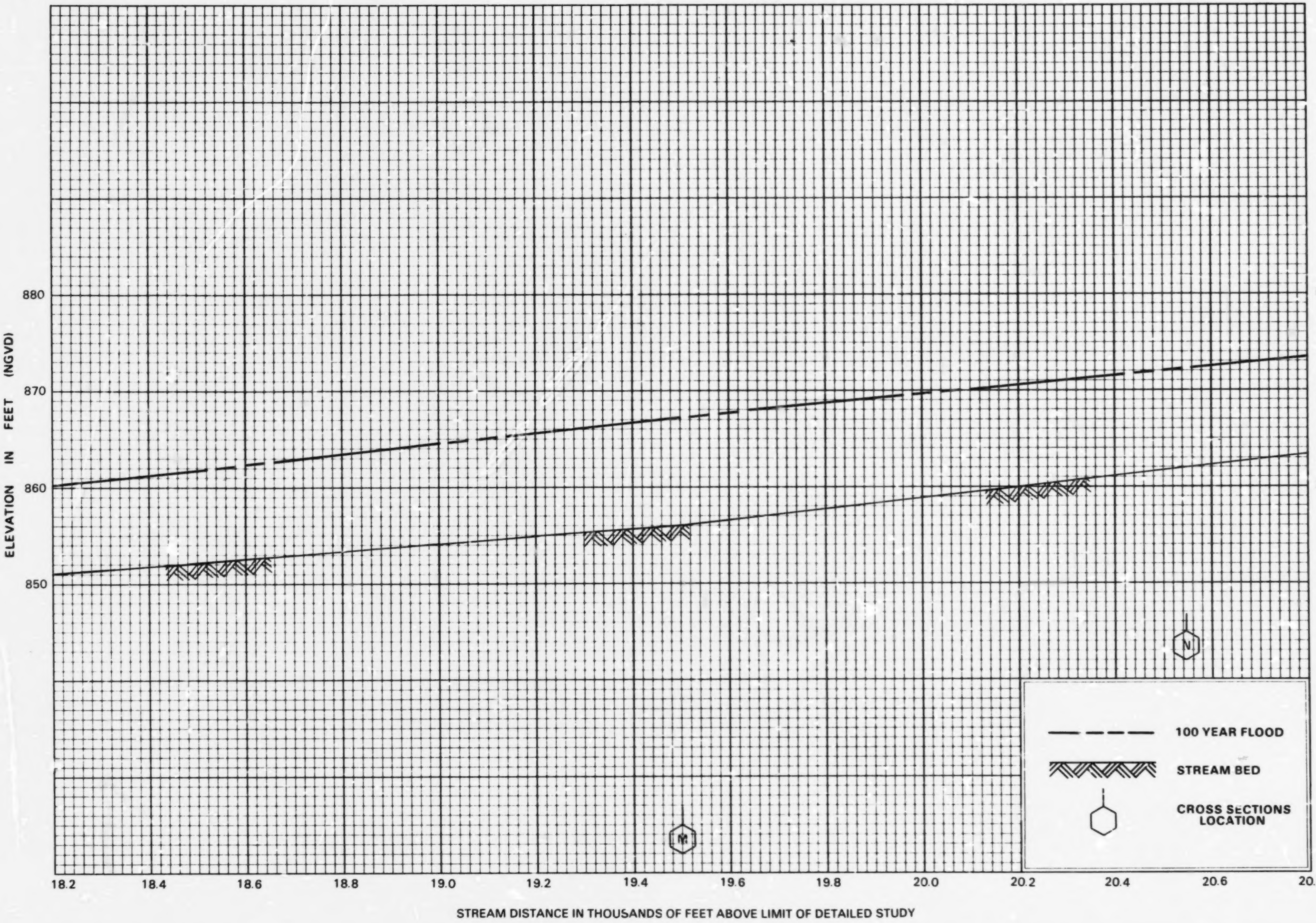
SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

13P

35



FLOOD PROFILES

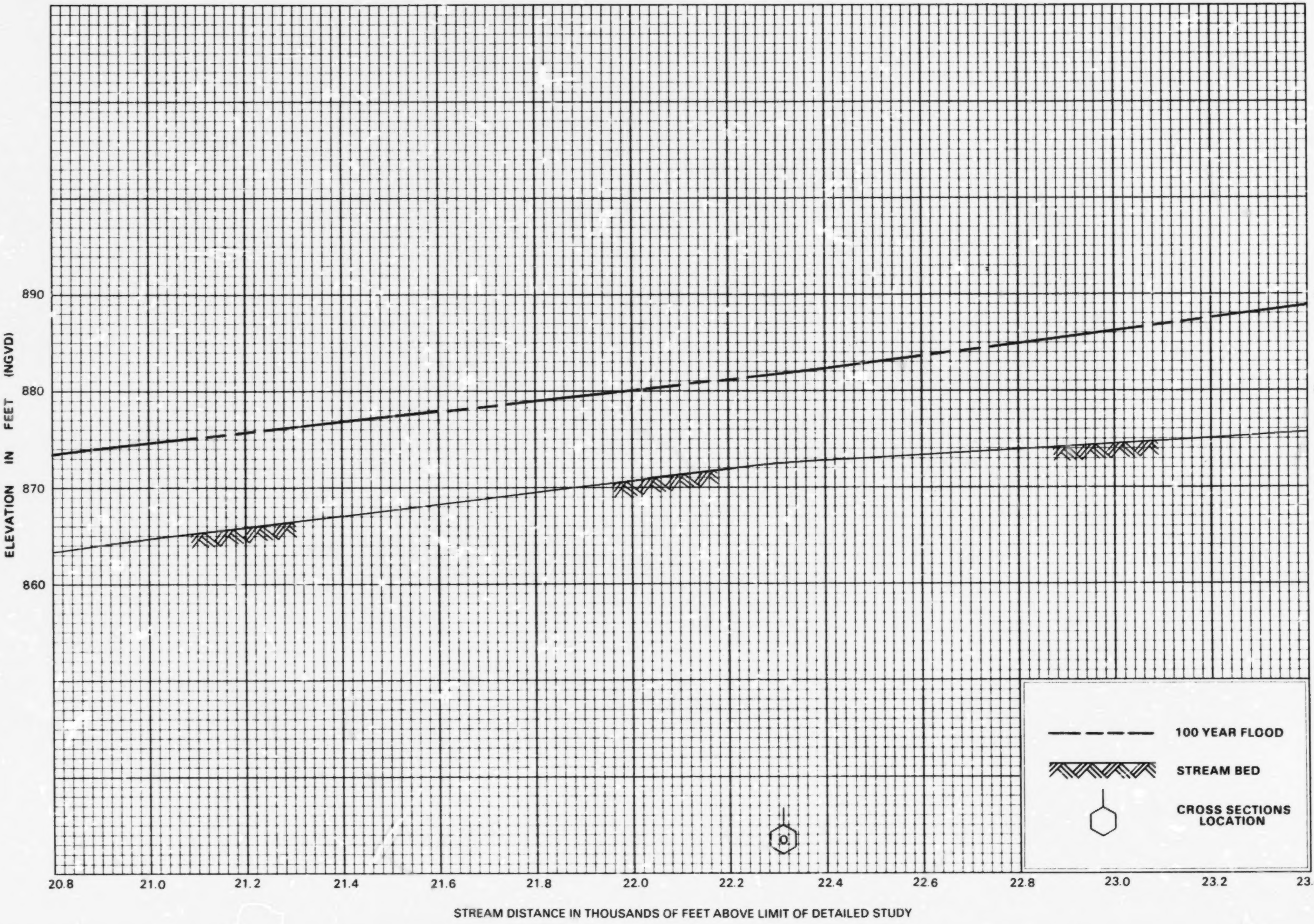
SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

14P

36



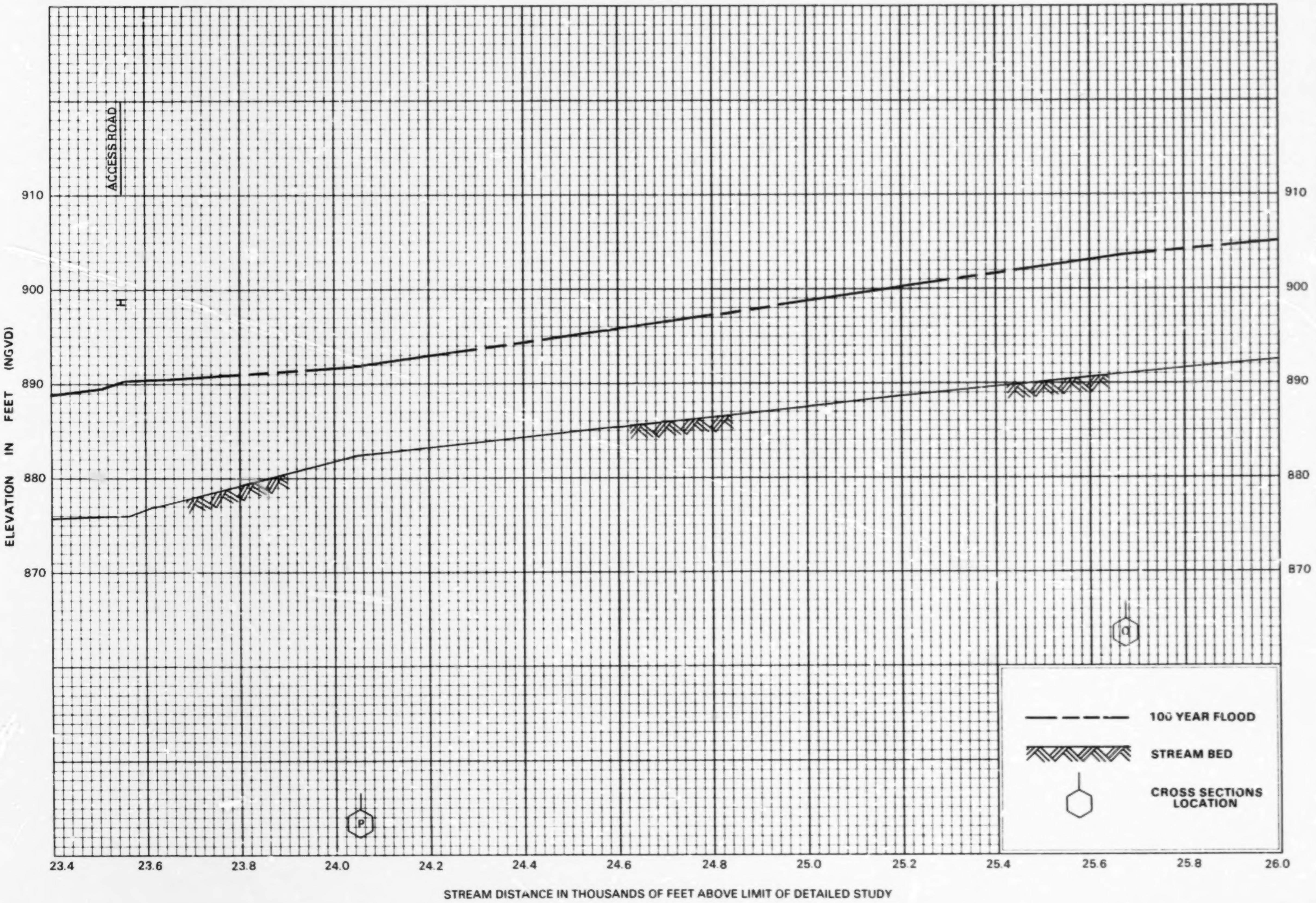
FLOOD PROFILES

SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

15P



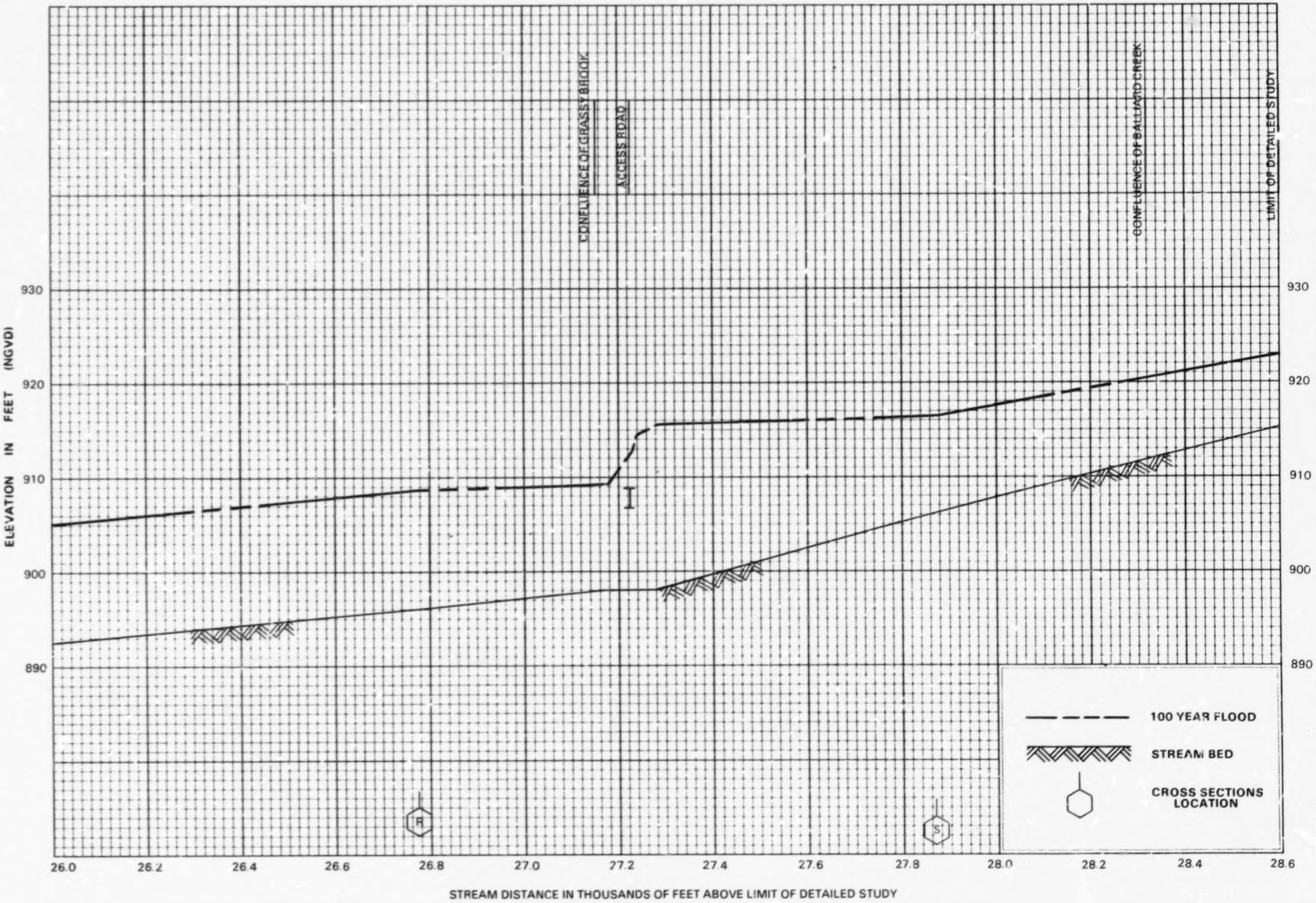
FLOOD PROFILES

SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

16P



FLOOD PROFILES

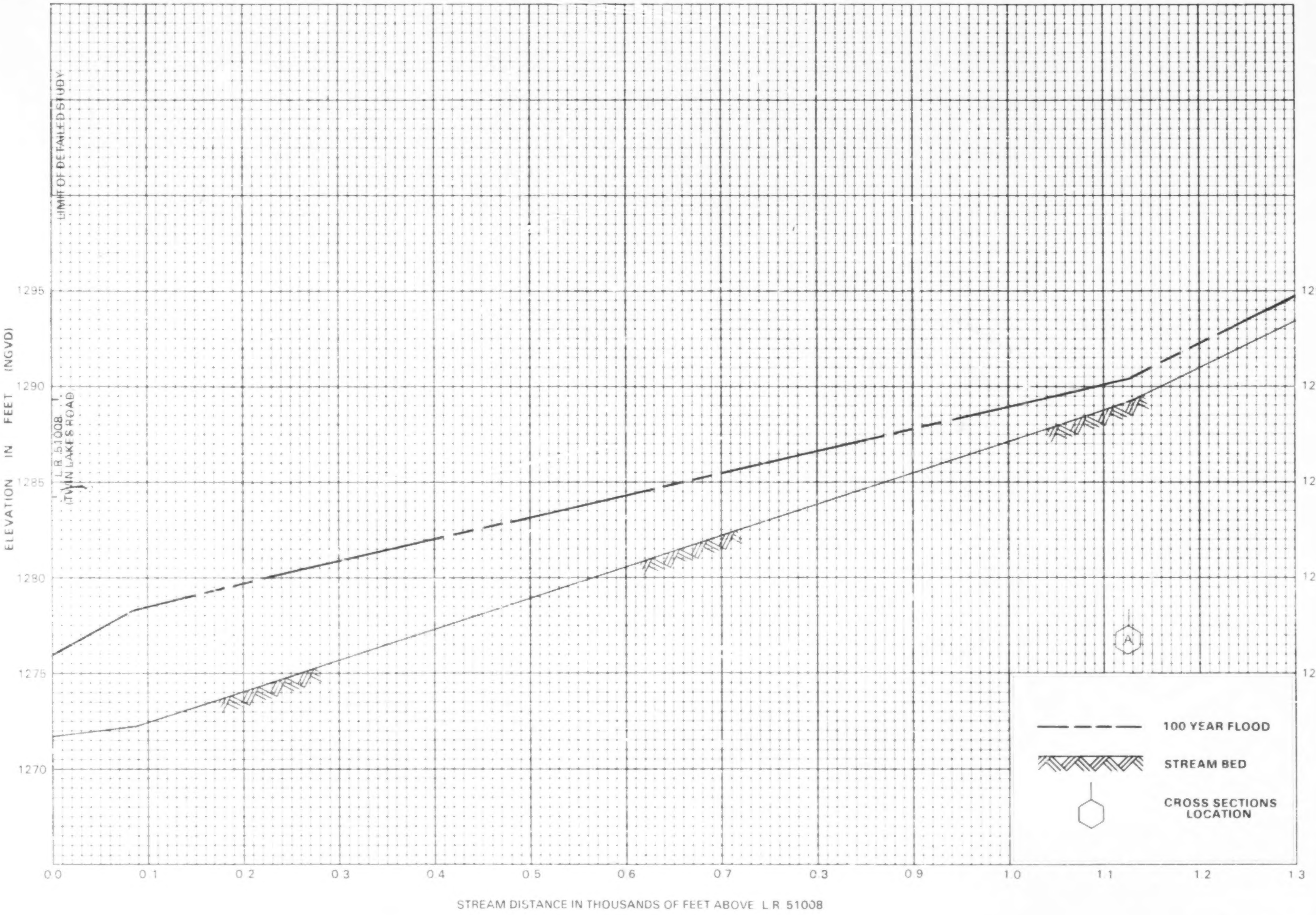
SHOHOLA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

17P

39

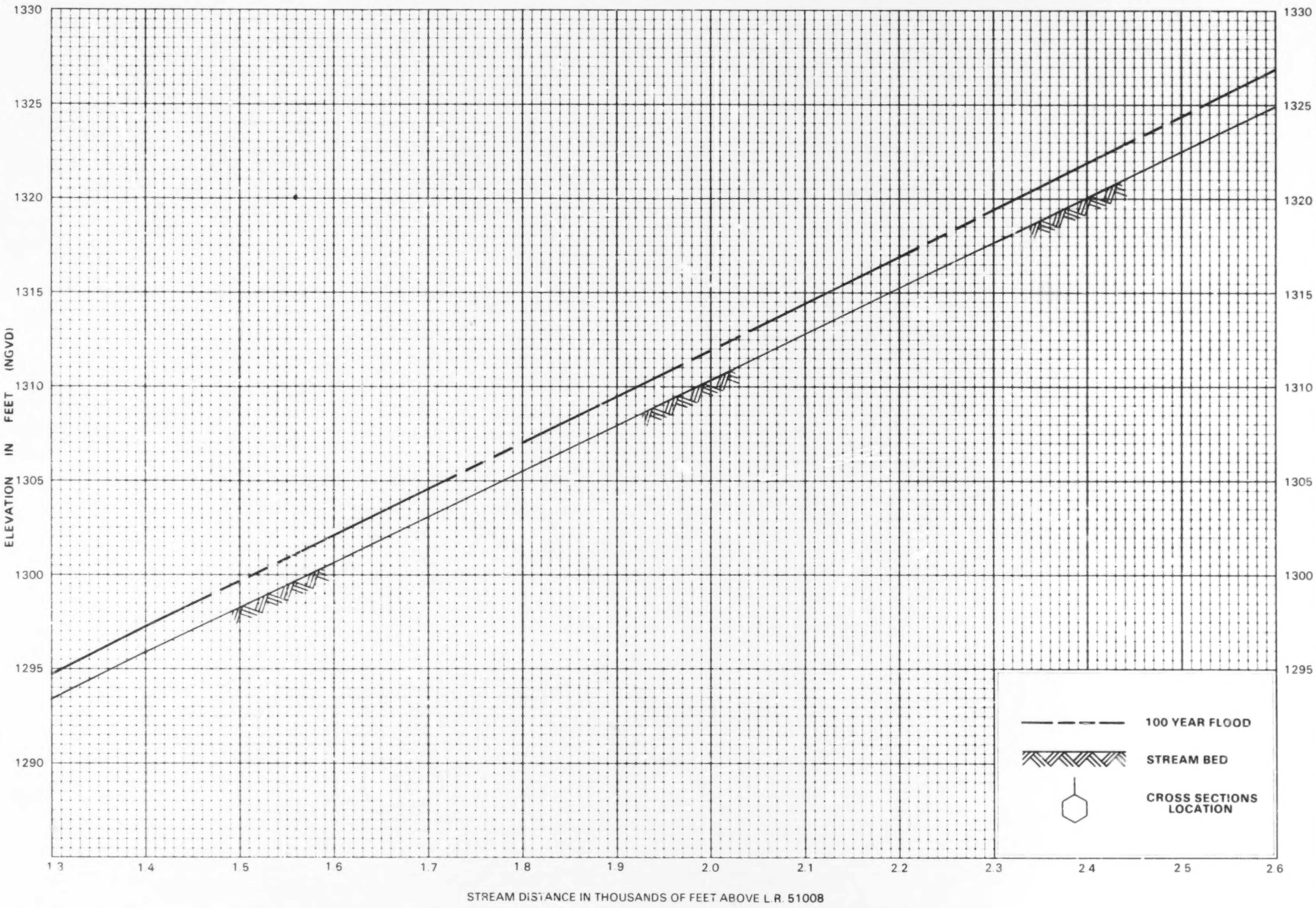


FLOOD PROFILES

TWIN LAKES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)



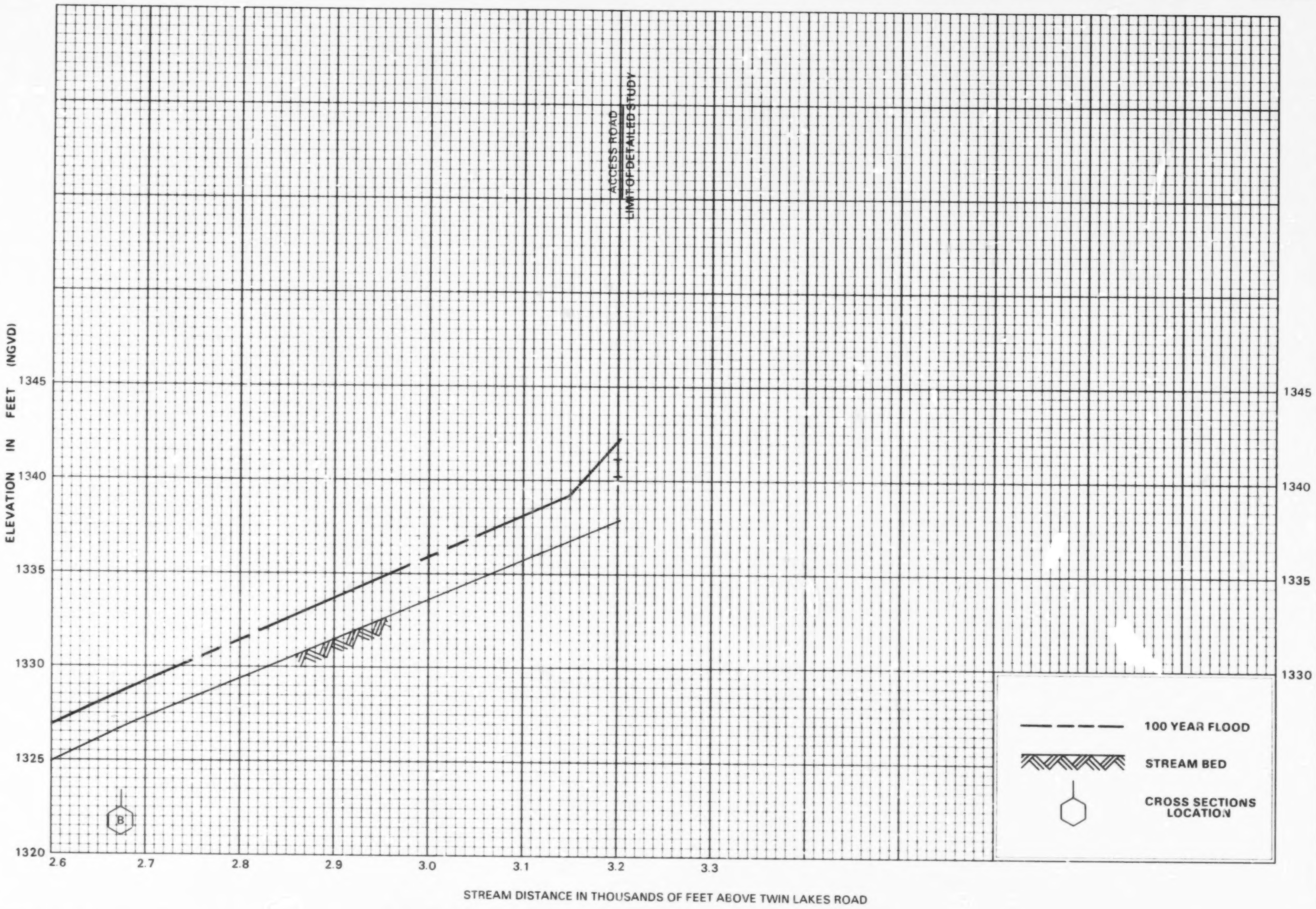
FLOOD PROFILES

TWIN LAKES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

19P



FLOOD PROFILES

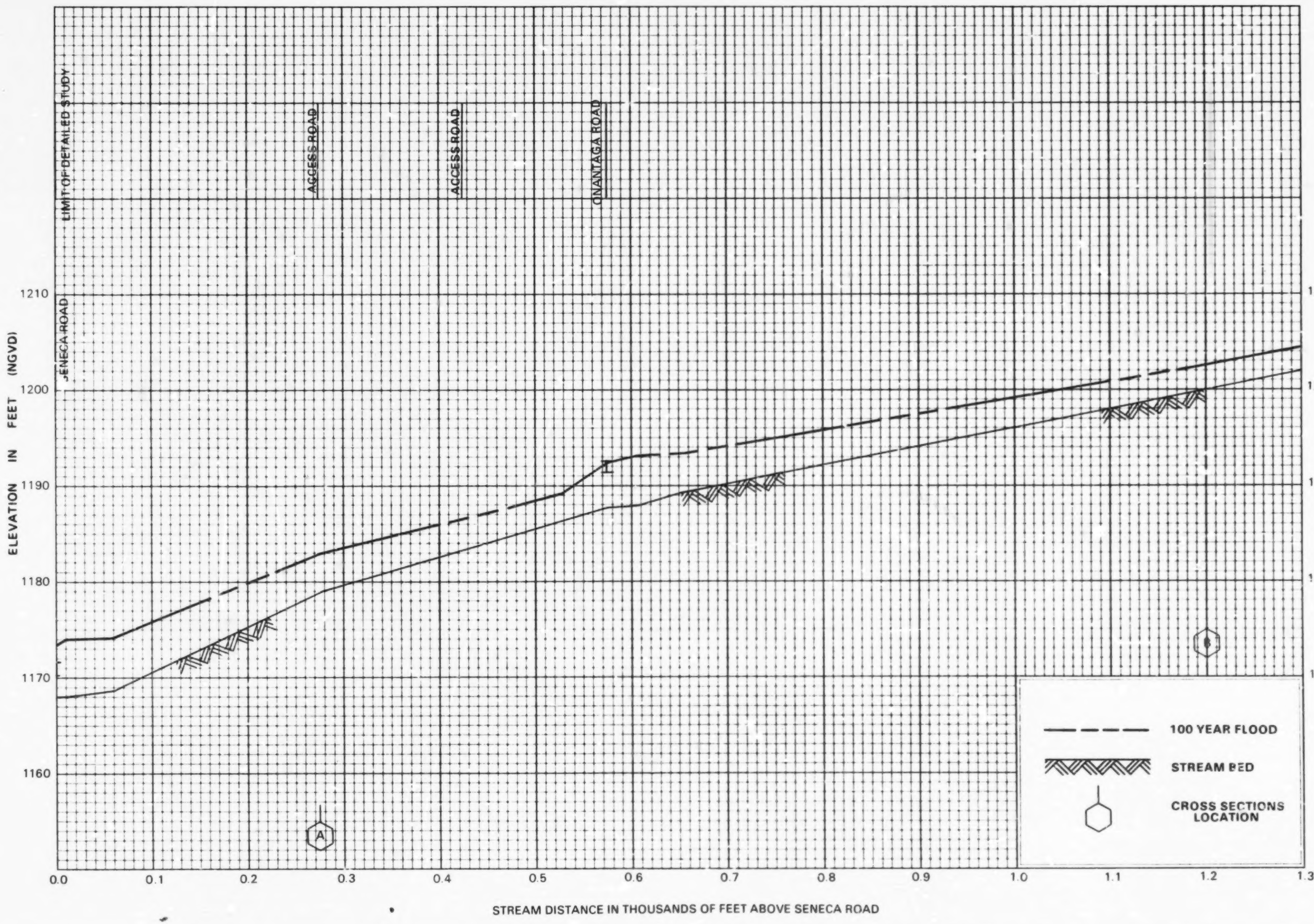
TWIN LAKES CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA

(PIKE CO.)

20P



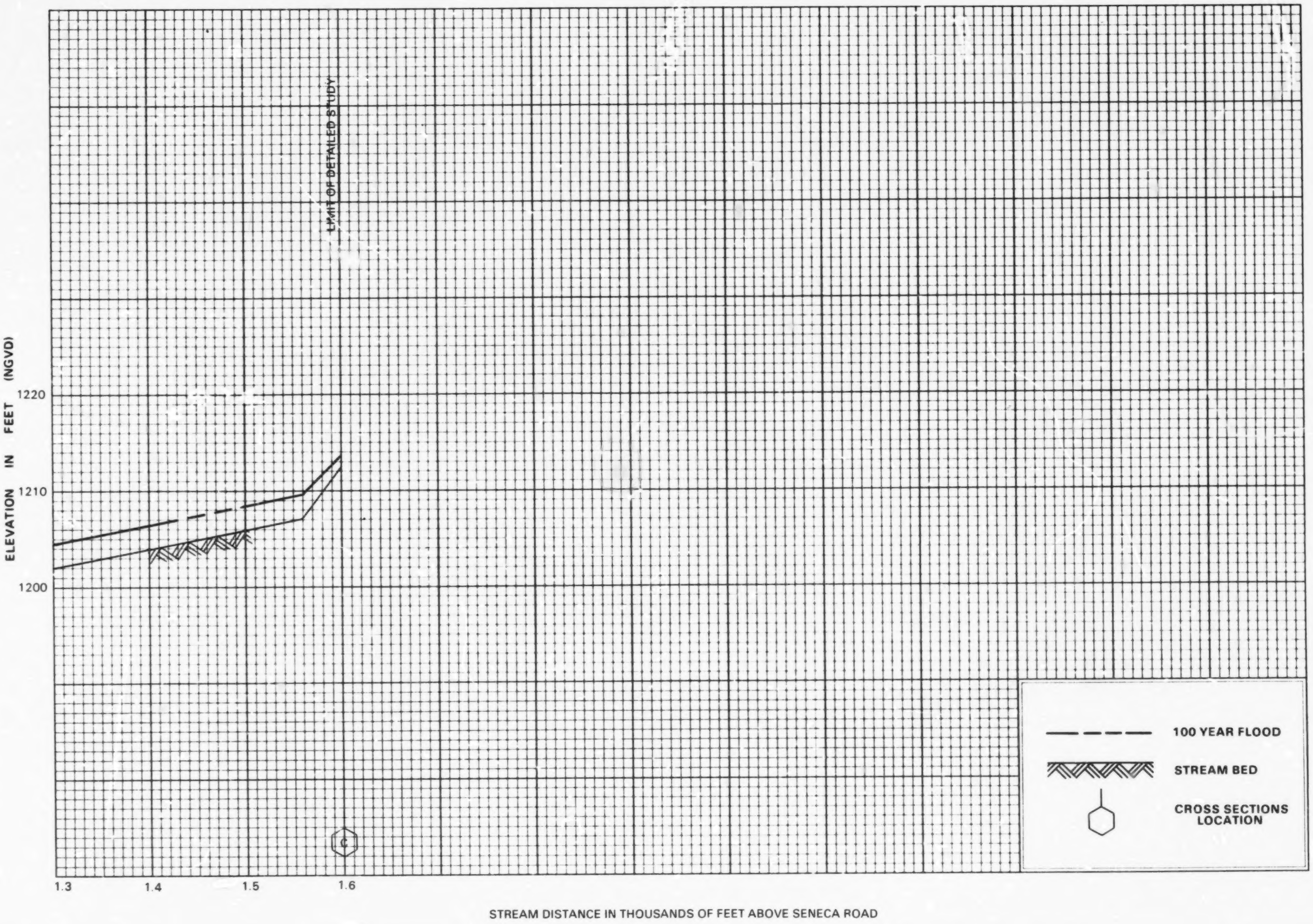
FLOOD PROFILES

WALKER LAKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

21P



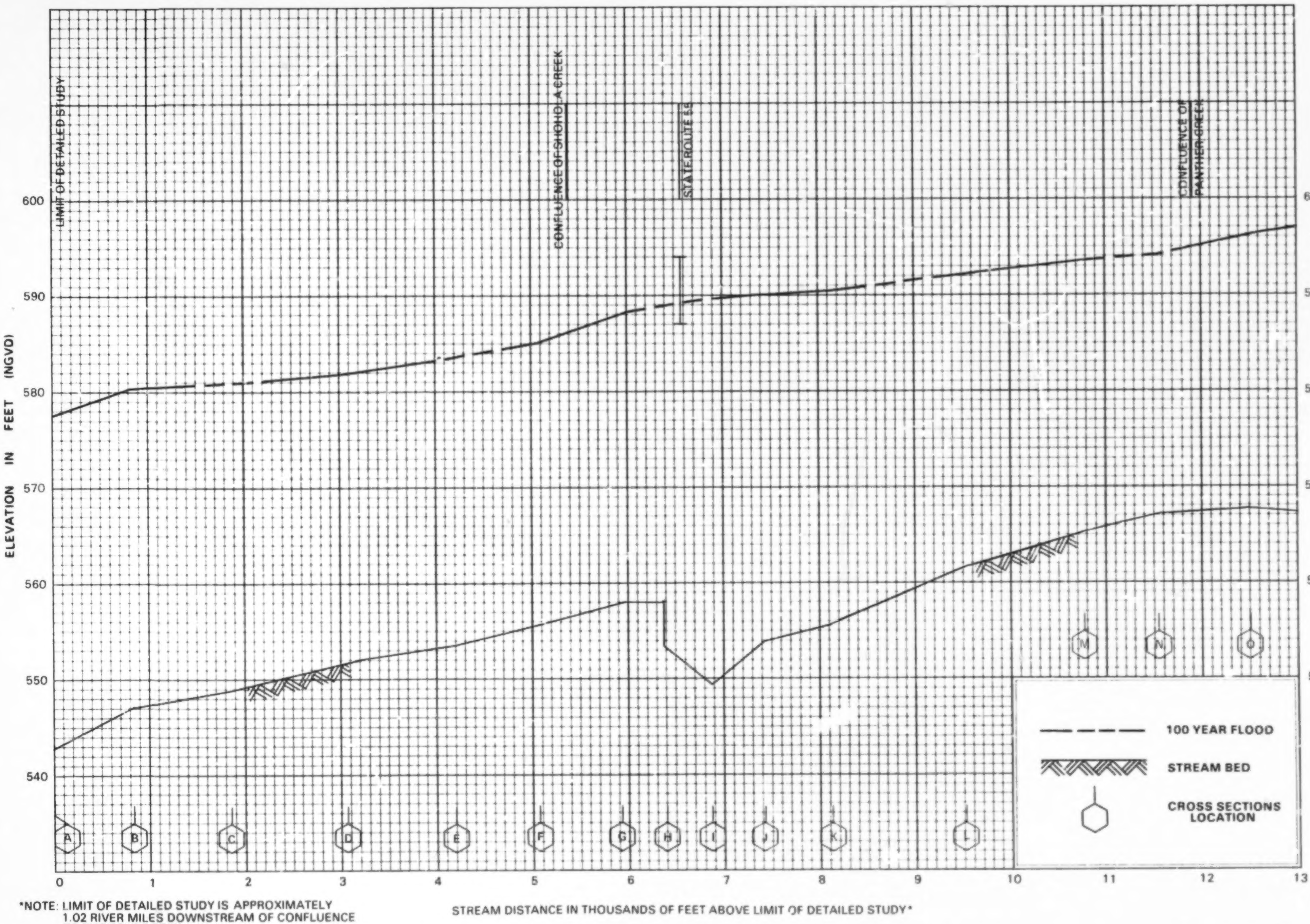
FLOOD PROFILES

WALKER LAKE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

22P



*NOTE: LIMIT OF DETAILED STUDY IS APPROXIMATELY 1.02 RIVER MILES DOWNSTREAM OF CONFLUENCE OF SHOHOLA CREEK

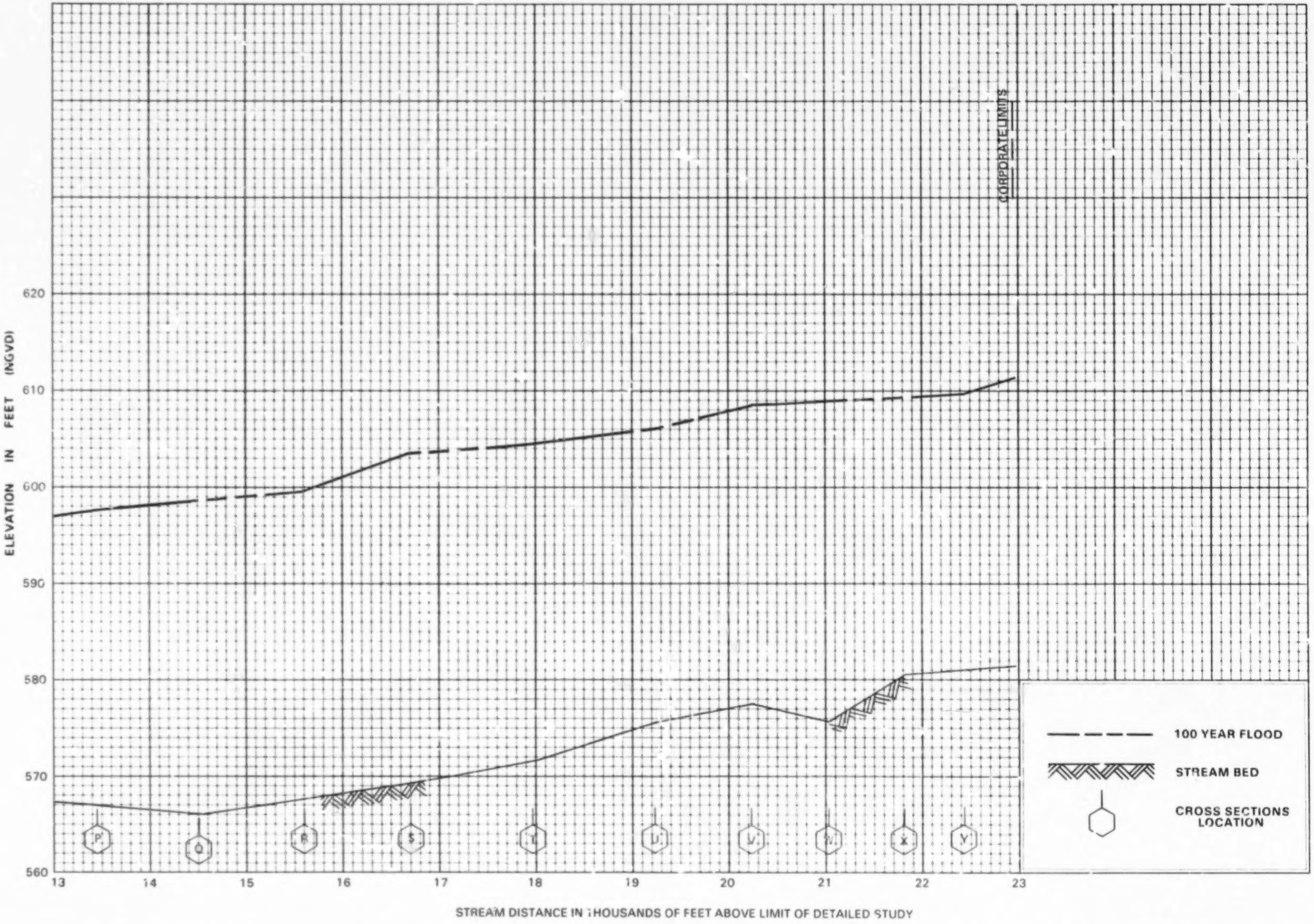
FLOOD PROFILES

DELAWARE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)

23P



FLOOD PROFILES

DELAWARE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF SHOHOLA, PA
(PIKE CO.)